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COMMUTATION OF THE COMPENSATED-SERIES-REPULSION MOTOR.

The alternating-current commutator motor for railway service is steadily going through the same process of evolution in regard to spark suppression at the commutator that its predecessor, the direct-current railway motor, has had to go through. The troubles with commutation that are presented in the design of the direct-current motor are reproduced substantially in the alternating-current motor, together with special difficulties peculiar to alternating-current machines. Nevertheless, the designer's difficulties tend to become no greater with the alternating than with the direct-current motor, as experience is gathered, because the vector diagram applies fairly closely to the phenomena of commutation in the former, whereas the vector diagram does not lend itself so well to illustrating the corresponding action in the direct-current machine. The particular kind of alternating-current commutator motor described by Mr. A. R. Dennington, in his article of this number, is a combination of a series alternating-current motor, a compensated motor, and a repulsion motor, the repulsion action being more prominent at standstill and low speeds, while the series action is more prominent at high speeds.

The compensating winding of this motor is connected in a separate secondary circuit from the series-motor windings, in such a manner that at standstill, the compensating winding receives its maximum impressed e.m.f. and the series-motor winding the minimum impressed e.m.f., whereas at full speed, these conditions are reversed. The machine starts, therefore, as a repulsion motor modified by its series winding, whereas at full speed, the action appears to become substantially that of a compensated series motor. One advantage set forth for the above arrangement is that a considerable starting current and starting torque may be obtained with a comparatively small starting current from the trolley. At the same time, however, as pointed out in the article, care must be taken that this induced starting current does not overheat the armature in case the machine is overloaded and fails to accelerate. There are several ways in which the action of this interesting combination motor can be analyzed. For instance, at starting, the action is such as virtually to displace the field polar diameters nearly 90 electrical degrees, whereby the short-circuited armature coils undergoing commutation are carried out of the alternating flux in the armature iron, and are brought near to the virtual pole centers. In this way we may conceive the short-circuit currents are kept down in strength.

TRAIN-LIGHTING SYSTEMS.

At the recent convention of the Association of Car-Lighting Engineers the relative merits of the three common systems of electric lighting for steam railway cars were extensively discussed. These systems are the "axle system," employing an

axle-driven dynamo, with regulating apparatus and storage battery on each car; the "head-end system," having a dynamo located in the baggage car or on the locomotive, with or without storage batteries on each car; and the "straight storage system," which depends entirely on storage batteries charged while the cars are at terminals. Each of these systems had its advocates. But even if each of the systems is satisfactory under the conditions which ensures its present use, it is a long step from the use of a certain system over a certain route with specially equipped cars to the standardization of electric lighting for all steam railroad lines, which is the end toward which we should strive. As was brought out clearly at the convention, the storage battery is essential for any system which is to provide continuous service for passengers, and either the head-end or the axle system could be adapted to universal application. With the latter, it would probably be necessary to equip with a dynamo each engine that would ever be called upon for passenger service. There would then remain only some uncertainty as to the amount of charge the various storage batteries on cars would receive. This, however, would tend to equalize itself if proper voltage were maintained on the train line, as under-charged batteries would receive the most charging current from the train line. While the head-end system would work well if it were once in general use, the difficulty of introducing it is considerable when only a portion of the locomotives or baggage cars in the country are equipped with generators. For this reason the self-contained features of the axle-lighting equipment have doubtless been responsible for its extensive use abroad, and may be the governing factor in the solution of the electric train lighting system in this country. At the convention a number of plans were suggested which would involve a cost less than a complete axle-driven equipment for each car, but, as was pointed out, a universal system will necessarily cost more than a system where only one or a portion of the members of a train are equipped with generating apparatus.

The Short-Period Carrying Capacity of Cables.

Electrically conducting cables are designed with reference to various duties and requirements, all of which have to be considered to some extent, and some one or few of which receive prominent consideration, according to the circumstances of the case. Thus, a cable must carry its maximum load current without an excessive drop of pressure. It must also be designed for economy in first cost and in maintenance, with regard to its working voltage. It must not absorb too much power in transmission—that is, its efficiency of transmission at rated load must be satisfactorily high. It must be laid down in such a manner as to be capable of being repaired, in case of breakdown, with the minimum expenditure of time and labor. Finally, it must not become overheated under the maximum working current. A cable subjected to steady rated load current is known to rise in temperature at a definite rate. To a first approximation, ignoring the change in resistivity of the conductor, the linear rate of heat development in the cable is constant, and the temperature rises logarithmically with time. The curve of temperature rise with time is, to this degree of approximation, the same as the curve of rise of current in a direct-current circuit containing resistance and inductance, after a constant voltage has been applied to the circuit. The current rises at first rapidly, and then more and more slowly, the exact rate depending on the electrical time-constant of the circuit. In the case of the steadily loaded cable, the temperature of the cable, in like manner, first rises rapidly, and then more and more slowly, the exact rate depending on the thermal time-constant.

From the temperature-time curves and formulas of loaded cables, particular cases of which have been recorded and published many times, it is possible to deduce the length of time during which a given overload current may be carried without exceeding a certain temperature elevation. Within the above-mentioned degree of approximation, the law is precisely the same as that of overload applied to a motor. A duct-current railway motor, for example, will carry its steady load current and deliver its corresponding steady load mechanical power for an indefinite period without overheating. It will, however, carry overload currents, and give overload power, for definitely shorter intervals without exceeding the same limits of temperature, and if the needs of the railroad schedule are such as to require such overload currents for no more than these definite times, the motor will not become overheated, and in this sense will not be overloaded by the schedule. It is customary, in fact, to supply charts of such overload temperature-time curves with traction motors, by means of which the purchasing engineer can ascertain whether a given motor will comply with the schedule imposed by his particular conditions of traffic.

Mr. Wm. A. Del Mar develops a corresponding formula and table for cables in such a manner as to determine their overload time-current curves when the time of heating the cable to a given fraction of its maximum temperature elevation by a single steady current is obtainable. In this manner a cable may be properly installed under intermittent loads which would be excessive if carried indefinitely. For intermittent-load service, a chart of such safe time-current curves for any cable would be properly called for by a purchasing engineer, similar to those provided for traction-motors under intermittent loads. The particular form of the result sought in Mr. Del Mar's article is the time in minutes that a cable can safely carry an assigned steady current in amperes in order not to exceed a certain temperature-elevation in degrees Fahrenheit. The customary use of the degree Fahrenheit, with the pound avoirdupois, the British thermal unit, and corresponding specific heat units, leads to a distressing conglomeration in connection with the joule, ampere and watt. The formulas thus have the appearance of being comparatively difficult and complicated, whereas, when expressed throughout in metric units, they are very simple to write down, to think about, to remember and to apply. Engineers certainly have to pay heavily for the backward state of metrology in English-speaking countries.

The Mechanical Equivalent of Light.

An interesting resumé of the much mooted subject of the mechanical equivalent of light, by Mr. J. S. Dow, will be found in another column. The term which forms the subject of the article is rather a misnomer, since light is really a physiological concept, having no fixed dynamical relation to ordinary systems of energy. To give it a mechanical equivalent is something like trying to find a mechanical equivalent of smell, which like-

wise involves physiological factors. However, it is possible to ascertain at least approximately what proportion of the total radiant energy from any source lies within the limits of the visible spectrum or any portion thereof, and in so far forth to find for the source the total energy input required to maintain a light, let us say, equivalent to 1 candle-power. Thence one can go on and determine the input of energy within the limits of the visible spectrum required to produce the physiological effect equivalent to 1 candle-power. And finally by applying the luminosity curve of the eye one can find the energy input required to give for any given color the effect of 1 candle-power. The maximum light-giving efficiency would evidently be reached if all the energy input produced radiant energy of the wave length of maximum luminosity. But nevertheless there is a large chance for variation since the wave length of maximum luminosity is itself a function of the light intensity, shifting from about 0.59 μ at a few 10/1000 of a foot-candle. Mr. Dow very ingeniously suggests that in lighting important streets where the intensity is very low it might be well to use light near 0.525 μ in wave length to secure greater visual efficiency. In theory this is correct, but in practice intensities so low as to make this expedient useful ought not to be employed.

One ordinarily comes back to the question of possible lighting efficiency expressed in candles per watt of lamp input, based on practical illuminants. So far as we recollect, the highest figures yet recorded for actual commercial lamps are from Blondel flaming arcs, and run not far from eight mean spherical candles per watt. This is a tremendous result compared with anything obtained from ordinary arcs or from any form of purely incandescent solid, and it must be charged mainly to the fact that the spectrum of this arc is chiefly that due to calcium fluoride, which is especially bright in the region which gives the highest luminosity. The investigation of the distribution of intensity in the spectrum of the flaming arc involves enormous difficulties on account of the narrow bands that must be observed and the inevitable fluctuations, so that the actual meaning of the figures just quoted cannot be properly analyzed. Mr. Dow has worked out from the known luminosity curve at ordinary intensities the relative efficiencies of lights of various definite colors based on Dr. Drysdale's recent experiments on light of wave lengths 0.54 μ, a yellowish green, from which data one could go on and evaluate a discontinuous spectrum of which the relative intensities had been determined. Assuming the correctness of Dr. Drysdale's fundamental estimate, one should get for monochromatic yellow light about 27 candles per watt. For reasons which Mr. Dow points out, all the theoretical determinations of a mechanical equivalent for light are open to some doubt, and in fact are rather discordant. The whole subject needs threshing over on a more elaborate scale than has yet been attempted, especially with reference to color values.

From a purely practical standpoint the important question is to determine, if possible, the theoretical limit of light producing efficiency toward which we are at liberty to work. On the face of things no simple incandescent body at any attainable temperature is likely to produce light very efficiently. To be sure, there are some material variations from black body radiation, but none of them seems likely to be of a magnitude to produce important practical results. From all the data thus far gathered it looks as if the only way to get far away from black body radiation with its temperature limitations is to go deliberately to gaseous sources giving discontinuous spectra. Even these may fail to give high efficiency by reason of strong infrared or ultraviolet radiation, as in the case of helium, suggested by Nutting as a primary standard. The modern flame arcs have a good spectrum from the standpoint of the luminosity curve, but are very far from white in color. The luminous arcs of the iron and titanium class gain in color and correspondingly lose in efficiency, as do all the white flame arcs. Any spectrum rich in red or in blue rays is put at a great disadvantage on account of the luminosity curve. Even the clear blue-green suffers in this particular, being, as Mr. Dow's figures show, about on a parity with the clear red, and standing at 8 or 10 possible candles per watt instead of 27. Mr. Dow raises a very interesting point in this particular as regards the luminosity equivalents of mixed lights. Suppose one could make a mixture of a green and a red, each standing theoretically at 10 candles per watt. Would the resulting tint, which would be much nearer white than either of its components, stand for the same candles per watt? In other words, do color impressions add in the numerical sense or not? The general impression from experiments is that they do so add, and yet, as Mr. Dow suggests, the question can hardly be regarded as closed, and in the present state of color photometry will be difficult to settle.

Indeed, it is difficult to say how the color trouble is to be avoided. And even granting that it can be, there is still an outstanding difficulty in blending lights from widely distant parts of the spectrum, due to chromatic aberration in the eye. The focal surfaces for red and green do not coincide, and if the particular red and green were actually balanced in luminosity, the resultant tint might be very bad to work with for the reason that while the physiological color impressions would blend, the physical rays would not, and the result would probably be distressing. This matter of local difference for differently colored lights is sometimes important. For example, flaming arcs and mercury arcs, which both give constructed though discontinuous spectra, certainly tend to improve definition, while purplish light obtained by screens otherwise gives singularly bad definition. If one could reproduce the light of the firefly, as investigated by Langley, the shortened spectrum would be excellent in addition to the apparently very high efficiency. But no substance or mixture of substances is known which gives anything even remotely resembling the spectrum of the firefly's light as given by Langley, and to tell the truth, it looks suspiciously like a mere low-intensity spectrum in which rod-vision predominated. His experiments should certainly be carefully repeated before accepting the conclusion that any natural substance can give a continuous spectrum within so narrow limits, and without energy elsewhere than in the visible spectrum. It is one of these things which impresses one queerly. Meanwhile, we may well congratulate ourselves that in modern incandescents one candle per watt is easily attainable and in modern arcs easily from two to four candles per watt. This is a long step in advance of the earlier figures and enough to be satisfied with for a while during the progress of experimentation. The next great advance may have to wait 15 or 20 years more.

Electrification of Pennsylvania Tunnels.

A further step in the supply of electrical transportation facilities to New York was taken last week when the Pennsylvania Tunnel & Terminal Railroad Company decided to adopt direct-current third-rail for the operation of the Pennsylvania tunnels under New York City, although it had been expected that the alternating-current overhead trolley system would be used, experimental single-phase locomotives having been built for the Pennsylvania Railroad and subjected to exhaustive tests. A five-mile test track, equipped with various forms of 11,000-volt overhead trolley, was built on Long Island for the purpose of determining the best form of construction to use in the event of a decision in favor of that system, and about a month ago the contract for the electrical equipment of the tunnels was awarded to the Westinghouse interests.

It is now stated that direct current was selected solely because in the opinion of the engineers of the railroad company it was best suited for the service to be performed in the electrified zone and as fitting into the system already in service. There have been many rumors that the Pennsylvania Railroad would electrify its entire New York division as far as Philadelphia, and even farther west, and this problem has certainly been studied; but that may be some time in the far future, it is now said; and the plans considered for this project have had absolutely no influence in determining on the system now to be employed in the terminal district between Newark and Long Island City. Protected top-contact third-rail, carrying approximately 600 volts, will be used and three-phase, 25-cycle currents at 11,000 volts will be transmitted from the Long Island City power station to substations located at suitable points. The electric zone will include the present four-track main line from Newark to the Jersey City Terminal, the double-track approach to the North River tunnels from the new locomotive terminal to be built at Harrison, N. J., the two single-track tunnels under the North River, the terminal station yards and tracks between Seventh and Tenth Avenues in New York, the four-track cross-town tunnels leading to the four tubes under the East River which emerge in the Long Island City surface yards, such further tracks of the Long Island Railroad as are required to round out the complete electrification of the Long Island suburban territory and the belt line connections to the proposed Ward's Island bridge and Bay Ridge, Brooklyn. All suburban trains are to be made up of steel motor cars and trailers with multiple unit control; and through trains of both the Long Island and the Pennsylvania Railroads will be hauled through the electric zone by electric locomotives of a design not yet fully decided upon. Even though the Pennsylvania Railroad goes no further than this for the present, this new development involves a great deal of work.

Investigation of New York City Central Station Companies.

The investigation by the New York Public Service Commission, First District, started for the purpose of determining whether an order should be issued by the commission containing provisions in regard to the publication of rates and deviation therefrom, intended to insure uniform dissemination of information as to rates, contracts and practices and to prevent discrimination, was resumed at a hearing on Nov. 24.

Mr. J. W. Lieb, Jr., associate general manager, New York Edison Company, stated that since the last hearing, a report of which in abstract appeared in the issue of Nov. 28, page 1162, his company had given further consideration to the proposed order. It felt more strongly than it did at the last hearing that it would be practically impossible to comply with the order in the sense in which it was interpreted by Commissioner Maltbie at that hearing. While the company was in sympathy with the issuance of an order against discrimination and with the intent of the order so far as it related to the general publication of the schedules, it was not in sympathy with a reading of the order that would make it impossible to recognize the fundamental commercial principles which underlie the business. The importance to the company of having a certain leeway in the negotiation of important contracts arises from the fact that the business is very largely competitive. The company must recognize that it had as isolated plants and in large customers potential, effective and competitive agents. Mr. Lieb thought it was absolutely necessary that the company should be in a position to make rates that would enable it to get the wholesale business; and it was able to make such rates without resorting to any unreasonable differentials. It was absolutely essential to obtain the large amount of available wholesale competitive business, and in order to do so personal negotiations with the customer, often in consultation with his attorney, were required. The customer would be dissatisfied sometimes with the technical reading of wholesale contracts submitted and it has been found necessary, in order to meet his wishes, to make changes in the form and the verbiage. Those departures, as the company had tried to make clear to the commission, were not such as affect the rates. It was found on going over a large number of contracts that there were many departures of this nature. This class of business was entirely different from that of retail customers. To adhere to a technical interpretation of the proposed order would place the company at a serious disadvantage in the conduct of its business, and would react on the body of its consumers at large. The company felt that certain details might be left open under the order, provided they were not unjustifiably differential or discriminatory, and provided, further, that they did not affect the rate and the essentials of what the customer received and the manufacturer gave, but represented real service conditions under wholesale supply.

Mr. Frank W. Smith, secretary, United Electric Light & Power Company, said he did not oppose the issuance of the order requiring that a schedule of rates be filed and be kept open for public inspection, nor the requirement that no modification be made except on 30-days' notice nor standarization of the form of the schedule. The company, however, did urge a modification in the requirement that every minute detail complying to general rules and regulations and apparatus furnished be set forth. A literal interpretation of the order in its present form would eliminate from the business all commercialism, permit no leeway or discretion in the treatment of the customer and, it was believed, would defeat the object of the order. The company believed that no confusion or misunderstanding existed with the general public as to the various rates now in effect. It was of the opinion that the order in its present form, however, was unnecessarily confusing, and would be extremely difficult, if not impossible, to carry out conscientiously.

Mr. Adrian H. Larkin, of the Richmond Light & Railroad Company, asked if it was to be assumed that the necessity for the order had been passed on by the commission, and that the legality of the power of the commission to impose such a condition had been passed on. Commissioner Maltbie replied that the power of the commission had been passed on by counsel to the commission and, as in all other cases, the necessity of the order had been brought out in a general investigation and had been emphasized many times by the complaints of consumers. The counsel had given an opinion that the commission had the right to issue such an order as that before the meeting. In answer to a question from Mr. E. D. Hawkins, Queens Borough Gas & Electric Company, Commissioner Maltbie said that there was objection to making that opinion public. The opinion of counsel was strictly a commission matter. The general scope of the opinion was that the commission had the power to issue the order.

Mr. Larkin said that the act seemed to give power to direct the method of bookkeeping and perhaps might indicate what the books should contain in some cases, if required for the information of the commission, and that the commission had the right to indicate how the annual reports should be made. He did not find anything else in the act giving power of the

kind that was claimed. Mr. Larkin said that the question had arisen by reason of the fact that in the railroad portion of the act provision was made for schedules, but such provision was omitted in the electrical portion. Commissioner Maltbie said that the two portions of the act were different because they came from different sources; one was general in language and the other specific. Mr. Hawkins said he assumed that there would be no disposition to construe any participation in the discussion as an admission as to the scope of the power of the commission. Commissioner Maltbie said it could be assumed that all interests had reserved all the rights they might have.

Mr. Charles F. Mathewson, New York & Queens Electric Light & Power Company, said he felt that any order requiring such detail as that under consideration would hamper the companies in their business so seriously that it would be a public misfortune. He would suggest a change providing that a copy of every form of contract, schedule of rates and riders applicable thereto should be on file so that the public could see just what the schedules are. The argument of Mr. Mathewson, Commissioner Maltbie thought, resolved itself into a suggestion to take out of the order the conditions of supply and regulation. He was willing to discuss the question of altering the order in that respect, but did not want to be understood as eliminating the words suggested. He asked whether certain conditions of supply and regulation were not made part of the contract. Mr. Mathewson said that all conditions which the company considered essential were included in the form of application that had been passed upon already.

Mr. W. W. Freeman, Edison Electric Illuminating Company of Brooklyn, said that that company was already on record as stating that it was perfectly willing to have an order issued, if limited to a copy of the forms of contracts and schedules of rates and riders. If the commission wished to have the companies correct, in a general way, the terms as to the issuance of the order along those lines, all that remained to be done was to allow a reasonable time for reading over the proposed schedule, in order that the suggested modifications might cover those points. So much talk had been centered upon the idea of convincing the commission that the original scope of the order was unreasonable and unfair that the other point had not been reached.

Mr. Lieb said he thought the contract and specifications with the municipality of New York ought to be excluded. There were so many specifications and conditions in the city contracts that it would be undesirable to publish them in connection with the schedules of the company. Mr. Mathewson thought that the provision as to the form of the bill to be rendered should be struck out.

The hearing was resumed on Dec. 1, when Mr. E. D. Hawkins, Queens Borough Gas & Electric Company, stated that the attorneys representing the various companies had held a consultation with Mr. George S. Coleman, chief counsel for the commission, to discuss the situation from a legal standpoint. The question of the power of the commission to issue the order was discussed at length.

Mr. Adrian H. Larkin, Richmond Light & Railroad Company, stated that if it was the intention to close the hearing then he would like to go on record with reference to the schedule of the order, but if such was not the intention he thought the companies could agree upon an order that would be satisfactory to the commission.

Mr. Hawkins said that in his opinion the commission was not entitled as a matter of law to make such an order. Mr. Larkin said that he would suggest that the existing order be suppressed and that the commission take no further steps under the proceedings for the reasons that it had no power to do so under the act, and that it was an unnecessary interference with the property, rights and business of the companies.

Mr. Hawkins made the further objections that the commission had no power to provide that no rates shall go into effect except on 30-days' notice, these companies being existing companies and having existing rates. The grounds stated by Mr. Hawkins for his objections were as follows: That if there is to be any change of rate or notice such change of rate or notice should only be where the change increases the rate to the consumer; that to protect the public, which apparently is the object of the statute and the purpose of the commissioner, all that was necessary to do is to have a publication of the rates; that to compel a publication of the contract is to interfere with the private business of these companies and unjustified by the circumstances or by the law under which the commissioner is acting. Mr. Henry J. Hemmens, New York Edison Company, joined in the objections made by Mr. Hawkins.

The hearing was adjourned until Dec. 3.

Twelfth Annual Independent Telephone Convention.

The twelfth annual convention of the International Independent Telephone Association was held at the Auditorium Hotel, Chicago, Dec. 1, 2 and 3. The meetings of the association were held in the banquet hall on the sixth floor of the hotel, and the entire floor adjacent to the banquet room was occupied by the leading manufacturers and supply dealers who are seeking the trade of the independent telephone companies.

The following officers were elected for the ensuing year: President, E. H. Moulton, of Minnesota; first vice-president, P. C. Holdoegel, of Iowa; second vice-president, E. B. Fisher, of Michigan; third vice-president, J. F. DeMers, of Canada; fourth vice-president, W. J. Uhl, of Indiana; treasurer, Mansfield Savage, of Illinois; secretary, A. C. Davis.

The first session of the convention was called to order at 10 o'clock Tuesday morning by Acting President P. C. Holdoegel, of Rockwell City, Ia. After a few preliminary remarks, Mr. Holdoegel introduced Mr. George M. Bagby, assistant corporation counsel of the city of Chicago, who, in the absence of Mayor F. A. Busse, welcomed the association and the delegates to the city. During his address, Mr. Bagby said that the Chicago city officials were heartily in favor of independence such as that shown by the International Independent Telephone Association. Mr. H. D. Critchfield, of Milwaukee, Wis., responded to the address of welcome. He departed from the usual form of response by contradicting the assertions made in the welcome and by stating that the attitude of the city officials of Chicago is not in sympathy with independence, inasmuch as every movement started for the introduction of independent telephones within the city had been met by opposition from every department of the city administration. He said that Chicago is making a big mistake by failing to let down the bars which are keeping out independent telephones. He quoted statistics showing that there are 1,300,000 users of independent telephones in the region adjacent to Chicago who are seeking communication with the residents of that city. He declared there are approximately 10,000 people residing in Chicago employed in the manufacture of independent telephone apparatus, and that this number would be increased in wonderful proportions if an independent company were allowed to operate within the city. He said that notwithstanding these facts, the city officials of Chicago had shown that they were opposed to the entrance of an independent system by refusing repeatedly to grant independent companies franchises to operate within the city. In closing his address, Mr. Critchfield assured Mr. Bagby that what he had said was not to be considered as personal, but was to serve as a direct message to the mayor and the city council of Chicago.

In his combined report as secretary and treasurer of the association, Joseph B. Ware, of Grand Rapids, Mich., read an extended paper in which he reviewed the work done by the organization since it first came into existence. In this paper Mr. Ware urged that concerted action be taken by state and national independent telephone associations, and by all independent telephone companies for the protection of the independent movement. He cited many statutes that have had a direct effect on the future life of the independent companies, and made recommendations which he thought should be

adopted. He recommended that a certain sum of money should be set aside by the association to obtain increased publicity in telephone matters of national importance, and to correct erroneous statements made by competitors.

The sessions held Tuesday afternoon and evening were in charge of Gansey R. Johnston, of Columbus, Ohio. These sessions were in the nature of technical and practical conferences. This was a departure from the usual custom, inasmuch as the papers read and the discussions treated of practical and engineering problems rather than of the financial problems of independent telephone companies. Representatives from all parts of the United States participated in the discussion, and made recommendations of plans and economical methods to be followed in the maintenance of telephone plants.

At Wednesday morning's meeting, reports were read from many of the state independent telephone associations, in which general progress was shown during the past year. In Nebraska there was a general gain in business shown throughout the state, and it was reported that all independent companies are working together harmoniously for the upbuilding of the independent interests. In Arkansas and California marked improvements have been made during the year. In Canada the independent movement has been very encouraging, although in the western provinces progress has been slow. It was reported that Ontario is far in the lead of the other provinces in the matter of forming new independent companies. In Indiana, it was stated, the past 12 months have been spent in perfecting the existing plants and extending the toll line business. With but one exception, every county in Indiana is now served by independent lines. During the past year the State Toll Line Clearing House was organized. It has been proved that such an organization tends to stimulate toll line business.

In Iowa, it was stated, practically no opposition to the independent movement is noticeable. The secretary of the state association reported that the independents have one telephone installed for every seven people throughout the state. In Kansas there are practically 94,000 independent telephones in operation. In Michigan there has been a notable increase in long distance telephone facilities as a result of the development of the independent movement in the city of Detroit. Every company in that state reports larger gross earnings during the past year than for the previous 12 months. In Missouri there has been marked improvement shown in the service through the perfecting of the independent lines. There are 138,125 independent telephones in use in that state. In Ohio, where there are a total of 327,663 independent telephones in service, 19,989 new telephones have been installed during the 12 months. In Texas, some progress has been made during the year, but long distance service has been hampered by poor connections with the lines of the adjacent states.

Prof. Morgan Brooks, of the Illinois State University, read a paper on "Some Telephone Problems." Following the presentation of this paper, which treated in part of the induction troubles that are liable to arise on telephone wires as a result of the increasing practice of installing for electric railway use high-voltage, single-phase transmission lines, Professor Brooks excited greater interest by predicting that as a result of the single-phase traction lines becoming popular, great dangers are in store for telephone lines. With the growth of this method of transmitting current at high voltage it will be necessary to make laws and otherwise provide for the safety of telephones and telephone users. He brought out some very interesting points on the best method of meeting this new trouble, and a committee was appointed to make investigations and prepare reports for the benefit of all company members of the association.

Among other papers presented to the convention were the following: "Economical Developments of Toll Territory," by Frank F. Fowle, of Chicago, Ill.; "Standardization of Certain Instruments," by Gerald Deakin, of San Francisco, Cal.; "Economies in Handling Maintenance Men," by J. H. Ainsworth, of Dayton, Ohio; "Local Traffic," by A. J. Shands, of St. Louis, Mo.; "Phantom Circuits," by C. Ewing, of Buffalo, N. Y.; "Pole Supply and Preservation," by W. F. Sherfesse, expert, United States Forest Service; "Damage Suits: Their Prevention and Defense," by Wm. S. Hart, of Waukon, Iowa.

Independent Telephony in Chicago.

As a result of the advances made last week by the members of the International Independent Telephone Association while attending the association's convention here last week, the committee on gas, oil and electric light of the Chicago city council has asked the independents to confer with the committee to discuss the entrance of independent telephone lines into the city. The invitation was issued after a conference had been held between Aldermen Pringle and Snow, of the committee, and Mayor Busse. The members of the Independent Association have announced they will at an early date hold a conference with the city officials.

"Head-End" Train Lighting.

At the recent Chicago convention of the Association of Car Lighting Engineers, a committee consisting of Messrs. C. R. Gilman, Fred. M. Gary and W. L. Bliss submitted a report dealing with the lighting of trains by means of generators located on the locomotives or in the baggage cars. When the generator is placed on the locomotive it is driven by a steam turbine; when it is placed in the baggage car it is driven either by a steam turbine or by means of the axle of the car. The authors gave estimates to show that on a road operating 900 cars over 7500 miles of track the cost, including interest on investment in generating apparatus and batteries, depreciation on equipment, cost of fuel, labor, etc., would be $490 per car-year, or $1.34 per car-day. The record of operation of such a train-lighting system in use on the C., M. & St. Paul Railroad during the year ending October, 1908, shows that the average duration of failure of system to supply light was 41.6 seconds per day per car, there being 183 cars in service. The troubles were mainly due to defects in the steam supply system.

Power Development in Northern Canada.

In 1906 the city of Winnipeg called upon a board of engineers for a report as to the available hydraulic power sites upon the Winnipeg River. On the advice received from those gentlemen, Messrs. William Kennedy, Jr., of Montreal, Que.; Col. H. N. Ruttan, of Winnipeg, Man., and C. B. Smith, of Toronto, Ont., who reported on April 25 of that year, the city determined to proceed with the development of what was then known as the Thirty Foot Falls, a distance of 75 miles away.

Complete designs for the power plant, transmission lines and terminal station were then prepared under the superintendence of Mr. Cecil B. Smith, and throughout the past two seasons the construction of 25 miles of tramway has been proceeded with. It is now completed. The power construction department of the city is now engaged in the excavation of earth, under contract, upon the site of the works, and tenders are now being called, returnable on Dec. 28 next, for the rock excavation, for the construction of concrete and other dams and for the power-house building, all at Point du Bois, Man. Tenders are also being received for the supply of steel towers and transmission cable and for the erection of the transmission line between Point du Bois and Winnipeg.

It is anticipated that these works will be rapidly proceeded with and that the city will, at an early date, be supplied with its own electric power.

The ultimate capacity of the works will be 60,000 hp under a head of 45 ft. of water, and the installation at present to be made will have a capacity of 20,000 hp.

The consulting board of engineers consists of Messrs. Col. H. N. Ruttan, chairman; William Kennedy, Jr., and Prof. L. A. Herdt. The construction will be carried on under Messrs. Smith, Kerry & Chace, of Toronto, Ont., as engineers in charge.

Unveiling of an Ampere Tablet.

At Ampere, N. J., on Dec. 3, the French Ambassador, M. Jules Jusserand, unveiled a tablet to the memory of his distinguished fellow countryman and townsman, Andre-Marie Ampere, the famous French physicist. The tablet is the gift of Dr. S. S. Wheeler, and is placed in the beautiful new railway station at Ampere, built recently by the Delaware & Lackawanna Railroad Company. A brilliant sunshiny day favored the ceremonies, and the Ambassador was received at 3 o'clock at the factory of the Crocker-Wheeler Company, which immediately adjoins the railroad station. A procession was then formed under the escort of uniformed guards from the company's forces, and with the Ambassador were Mayor Cardwell, of East Orange; President Campbell, of the Newark Board of Trade; representatives of the four national engineering societies; R. W. Pope, secretary of the American Institute of Electrical Engineers; T. C. Martin, past president of the Institute and New York Electrical Society; Professors Crocker, Sever, Pupin and Arendt, of Columbia University; Professor Parmly,

AMPERE MEMORIAL TABLET.

of the College of the City of New York; Peter Cooper Hewitt, and Thomas Ewing. Dr. Wheeler was assisted by Gano S. Dunn, vice-president of the Crocker-Wheeler Company, and Mr. Rodman Gilder.

Within the station a platform draped with the American and French flags had been erected in one corner under the tablet, and the station itself was profusely draped in flags and was crowded to suffocation. The spectators included a great many ladies. The whole town was en fête for the occasion. Dr. Wheeler made an admirable address, outlining the career and work of Ampere, and referring particularly to the adoption of his name for the unit of electrical current. At his invitation the French Ambassador then unveiled the tablet, a beautiful work in bronze, of which a picture is here shown. He then made a most eloquent address expressing his pleasure as a citizen of Lyons to see this memorial to his fellow townsman and to find that through the energy and public spirit of Dr. Wheeler one more beautiful city bearing the name of a Frenchman had been placed on the American map. M. Jusserand remarked, however, that in this respect the honors were more even than Americans might suppose, for there are many streets and squares in France bearing American names; and he himself had spent his boyhood at Lyons in a street called Franklin. His felicitous address was applauded to the echo.

The tablet thus unveiled was received officially by Vice-President Caldwell, of the Delaware & Lackawanna Railroad, who thanked Dr. Wheeler for his generosity and congratulated him upon the enterprise that had built up Ampere, enabling the company to construct so handsome and commodious a station. It had been the intention of Governor Fort, of New Jersey, to attend the exercises, but he had had to proceed to New York at the request of Governor Hughes for a special conference at Albany; and therefore sent Dr. Wheeler a cordial message of appreciation. After the exercises, lunch was served in the executive offices of the Crocker-Wheeler Company, and the Ambassador returned to Washington by the evening train.

Alabama Light & Traction Association.

At a meeting of the representatives of the public service corporations of Alabama, held in Montgomery on Oct. 23, the subject of organizing an association to further the interests of the electric railway, electric light and gas companies of the State was discussed. Committees on by-laws and constitution, on nominations and on subjects were appointed, and a call was issued for another meeting to be held in Mobile on Nov. 23 and 24. At the session at Mobile on Nov. 23 the constitution and by-laws as proposed by the committee on that subject were adopted for the Alabama Light & Traction Association, and officers and an executive committee were elected. At the conclusion of the regular session on Nov. 23 those in attendance at the meeting visited the power house of the Mobile Light & Railroad Company. At the afternoon session J. B. McClary, general manager of the Sheffield Company, read a paper entitled "The Most Judicious and Effectual Way to Establish Just and Friendly Relations Between the People and the Public Service Corporations," and W. A. Heller, general manager of the Mobile Light & Railroad Company, read a paper entitled "Coal and Its Relation to the Boiler Plant," after which the power house of the Mobile Electric Company was inspected. In the evening a dinner was given to the delegates at the New Battle House by the Mobile Gas Company, Mobile Electric Company and the Mobile Light & Railroad Company.

On Nov. 24 at 10 a. m. the regular meeting was continued and papers were read by R. M. Jennings, superintendent of the Mobile Electric Company, entitled "Minor Power House Economics," and by W. N. Harris, assistant superintendent of the Mobile Electric Company, entitled "Electric Meter Practice." The delegates were taken on a trolley ride through the city in the afternoon, during which they inspected the plant of the Mobile Gas Company.

The officers of the association elected are as follows: President, A. H. Ford, president of the Birmingham Railway, Light & Power Company; vice-president, J. H. Wilson, president of the Mobile Light & Railroad Company; secretary-treasurer, Lloyd Lyon, secretary and auditor of the Mobile Light & Railroad Company; executive committee: the president, vice-president, and R. J. Chambers, president and general manager of the Montgomery Light & Water Power Company; J. B. McClary, general manager of the Sheffield Company; W. R. Hall, general manager of the North Alabama Traction Company, New Decatur, Ala.; T. K. Jackson, president and general manager of the Mobile Electric Company; R. L. Rand, general manager of the Anniston Electric & Gas Company. The committee on subjects is W. R. Hall, general manager of the North Alabama Traction Company; L. J. Davis, treasurer and manager of the Mobile Gas Company; A. R. Smith, secretary, treasurer and manager of the Demopolis Electric Light & Power Company. The question box is to be in charge of G. H. Schuler, president of Alabama City, Gadsden & Attalla Railway.

Electricity in the Washington Street Tunnel, Boston.

The new tunnel under Washington Street, Boston, which was opened to the public on Nov. 30, is an interesting installation from the point of view of the electrical engineer. It has been designed for use by elevated trains of the Boston Elevated Railway Company, under conditions of service which require a special consideration of the provision of safe and continuous traffic. The general plan is to stagger all platforms and run only one track to each. The only exception to this rule is found at the Union-Friend Station, near Haymarket Square, where the platforms are located opposite one another. As recently noted in these columns, the tunnel is entirely fireproof, the only wood in it being the ties under the rails and the stairway balustrades. Even reinforced concrete seats are used at the stations.

The energy for train service is supplied through an 85-lb. third-rail of T-section, carried on insulators resting on a long tie in each case. The third-rail is provided with a side shield of wood, although it is of the top-running type. The track is ballasted with rock throughout, and is bonded with two 350,000-circ. mil bonds at every joint. The 2,000,000-circ. mil cables that transmit the energy for the third-rails are run in vitrified duct conduits at the side of and below the track level. The two sides of the tunnel are fed separately, so that any trouble occurring on one side will not affect the operation of trains on the other track. Emergency cross-connections are installed at different points in the tunnel, so that one side can assist the other in times of trouble. All the third-rails are insulated at the end of each signal block, and jumper switches are provided on the track-level to allow different sections of the third-rail to be joined together if necessary. The tunnel, which is fed with energy from each end, is about 1.2 miles long. There is no center of distribution for third-rail energy, but at each station provision is made for disconnecting the third-rail in front of the platform if necessary.

The tunnel is lighted exclusively by 16-cp incandescent lamps run in series circuits of five each. In the tunnel proper the lamps are arranged in two rows on each side, the distance between each being 24 ft. on a side or 12 ft. on centers in the tunnel as a whole. Half of the station lamps are arranged to be automatically connected to the third-rail in case of failure of the supply of energy from the regular cables. The rest of the lamps can be connected to the third-rail by hand if necessary. About 1700 incandescent lamps are required in the tunnel as a whole, and at stations the average number of lamps is 150. Translucent bulbs are used in places where the eye would be offended by direct rays, although, in general, the lamps have been installed well above the direct line of vision. A prominent safety feature is the running of a line of 35 lamps above the platform edge in each station, at a height of about 15 ft. above the floor. Electrically illuminated signs are used for the train indications.

The Boston Elevated generating stations, at Lincoln Wharf and at Albany Street, provide the usual supply of energy for tunnel illumination in the order named, but if this supply fails, either through the regular lighting cables or through the emergency connection with the third-rail service, energy for tunnel illumination is then obtained from the Edison Electric Illuminating Company, of Boston. Automatic solenoid switches are installed at a distribution center at State Station to make the necessary connections in case of failure. After a source of energy has failed, another immediately takes up the load, and if the original source returns to condition, the service is automatically restored without an interruption of more than a fraction of a second.

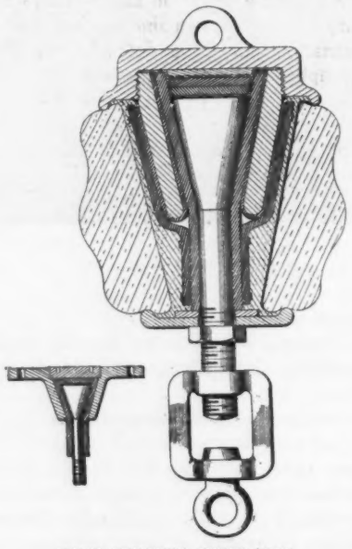
Electric motors are used in the tunnel for pumping and for driving fans, and at one station motor-driven moving stairways have been installed. The pump motors are directly connected to centrifugal pumps, with automatic float controlling apparatus. The tunnel is provided with an overhead trolley line, run throughout the entire length for use in case it becomes desirable at any time to run trolley cars through the tunnel for construction or other purposes. The trolley line is sectionalized to some extent, but not as thoroughly as is the third-rail, since its use will be infrequent. The New England Telephone & Telegraph Company has installed a series of public telephone booths at each tunnel station, the cables for this service being run through in lead-covered leads. In addition to these telephone lines, the Boston Elevated Railway Company has run its signal circuits, private telephone and telegraph wires through the tunnel. There are 16 automatic electro-pneumatic block signals of the direct-current type installed in the tunnel, one rail being set apart for the signal return line. The air for the mechanical operation is supplied at 90-lb. pressure from compressors located in various parts of the company's system, and the energy for signal operation is supplied at 110 volts through suitable resistances. All of the electrical equipment of the tunnel has been installed by the Boston Elevated Railway Company, which leased the tunnel following its completion by the Boston Transit Commission.

Electric Pumping at Hubbell, Mich.

The Houghton County Electric Light Company has closed a contract with the village of Hubbell, Mich., to furnish electricity for the pumping of city water. This water is drawn from 10 wells driven on the shore of an adjoining lake. The wells are not artesian, and the suction lift will be about 18 in. maximum. Water will be pumped to a reservoir about 200 ft. above the lake surface. Two pumps, each of 100 gal. per minute capacity, geared to 10-hp, two-phase, 220-volt induction motors, will be installed. The pumps are of the single-acting, triplex-plunger type. The contract covers a period of five years, and payments, which are based on the quantity of water pumped, will be as follows: Five cents per 1000 gal. for the first 1,000,000 gal.; 4.6 cents per 1000 gal. for the second 1,000,000 gal. and 4.2 cents for all over 2,000,000 gal.

High-Tension Insulator.

The accompanying illustration shows a high-tension strain insulator for which a patent has been recently granted to Mr. J. P. Nikonow. It comprises two conically-shaped metal parts,



HIGH-TENSION INSULATOR.

encircling one another with mica layers between. Sufficient extensions are provided for insulating material so as to avoid creeping discharge. With the same purpose, the whole insulator is fitted with a removable porcelain bushing, so arranged that its breakage does not affect for some time the proper work of the insulator. The patent rights for the insulator have been acquired by the Westinghouse Electric & Manufacturing Company.

Uniform Accounts for Electrical Corporations in New York State.

The New York Public Service Commission, Second District, has promulgated a uniform system of accounts for electrical corporations with annual revenues of above $500,000. A copy of the classification has been received through the courtesy of Mr. William J. Meyers, statistician for the commission.

An order of the commission, accompanying the accounts, provides that the balance sheet accounts shall be established as of Jan. 1, 1909.

The order states that on and after the date of its service no electrical corporation shall charge to any account representing cost of property any discount or commission on securities issued by the said corporation, but all such discounts, commissions, and other expense connected with the issue of securities subsequent to the date of service shall be charged, in accordance with the directions contained in the definitions of the account named "organization," and the account named "unamortized debt discount and expense," in the schedule of balance-sheet accounts.

On and after Jan. 1, 1909, the accounts prescribed or defined in the schedule of income account shall be kept.

During the year beginning Jan. 1, 1909, any corporation may for purposes of comparison with prior years keep on its books any account pertaining to revenues, revenue deductions, income deductions, and appropriations (as defined in the schedule of income account) which it had on its books during the year begun Jan. 1, 1908; provided that on or before Jan. 1, 1909, there be filed with the commission a statement containing a list of the accounts pertaining to the year begun Jan. 1, 1908, and definitions of such accounts.

For the purposes of improving the efficiency of administration and operation, any corporation may, unless or until otherwise ordered, keep upon its books any temporary or experimental accounts and any accounts covering particular divisions of its operations, provided that in each case the corporation shall file with the commission, at least 10 days in advance of the time when the said account is to be instituted, a statement showing the name of the account, the date when it is to be instituted, the purpose for which it is to be kept, the period of time during which it is to be kept, and a clear and accurate definition of the classes of items and facts to be contained in the account; and in case of a divisional account, the definition of the division covered. Upon compliance with the provisions of this paragraph, any account prescribed or defined in the schedules of balance sheet or income accounts may be subdivided.

All notices required to be filed concerning accounts shall be upon sheets 9½ in. x 12 in. in size.

Following is a list of the accounts:

SCHEDULE A—BALANCE SHEET OR INDICANT ACCOUNTS.

Fixed capital.
- Fixed capital, Dec. 31, 1908.
- Land devoted to electric operations.
- Organization.
- Franchises (electric).
- Patent-rights (electric).
- Other intangible electric capital.
- General structures.
- General equipment.
- Dams, canals and pipe lines.
- Power plant buildings.
- Furnaces, boilers and accessories.
- Steam engines.
- Turbines and water wheels.
- Gas producers and accessories.
- Gas engines.
- Electric generators.
- Accessory electric power equipment.
- Miscellaneous power plant equipment.
- Substation buildings.
- Substation equipment.
- Poles and fixtures.
- Underground conduits.
- Transmission system.
- Distribution system.
- Line transformers and devices.
- Electric services.
- Electric meters.
- Electric meter installation.
- Municipal street lighting system (electric).
- Commercial arc lamps.
- Glower lamps.
- Electric motors and heaters.
- Electric tools and implements.
- Electric laboratory equipment.
- Other tangible electric capital.
- Engineering and superintendence.
- Law expenditures during construction.
- Injuries during construction.
- Taxes during construction.
- Miscellaneous construction expenditures.
- Interest during construction.
- Land in other departments.
- Franchises in other departments.
- Patent rights in other departments.
- Other intangible capital in other departments.
- Tangible capital in other departments.

Floating capital.
- Materials and supplies.
- Cash.
- Bills receivable.
- Accounts receivable.
- Interest and dividends receivable.
- Other current assets.

Investments.
- Investments.

Special deposits.
- Coupon special deposits.
- Dividend special deposits.
- Other special deposits.

Prepayment accounts.
- Prepaid taxes.
- Prepaid insurance.
- Prepaid rents.
- Other prepayments.

Suspense accounts.
- Unamortized debt discount and expense.
- Other suspense.

Reacquired securities.
- Reacquired securities.

Debt.
- Funded.
- Unfunded.
  - Taxes accrued.
  - Receiver's certificates.
  - Judgments unpaid.
  - Interest accrued.
  - Dividends declared.
  - Bills payable.
  - Consumers' deposits—electric.
  - Other accounts payable.
  - Other unfunded debt.

Reserves.
- Permanent.
  - Premiums on stocks.
  - Other permanent reserves.
- Temporary.
  - Contractual.
- Required.
  - Accrued amortization of capital.
  - Unamortized premium on debt.
  - Other required reserves.
- Optional.
  - Casualties and insurance reserve.
  - Other optional reserves.

Stocks.
- Stocks.

SCHEDULE B—INCOME ACCOUNT.

Operating revenues.
- Municipal street lighting—arc.
- Municipal street lighting—incandescent.
- Lighting municipal buildings—electric.
- Municipal heat and power—electric.
- Miscellaneous electric revenue—municipal.
- Commercial flat rate lighting.
- Commercial flat rate power.
- Commercial metered lighting
- Commercial metered power.
- Railroad corporations.
- Other electrical corporations.
- Rent of electric meters.
- Rent of electric appliances.
- Electric merchandise and jobbing revenue.
- Sale of by-products.
- Joint electric rent revenue.
- Break-down service.
- Other miscellaneous electric revenue.

OPERATING EXPENSES.

I. Production expenses.
- Station superintendence and care.
- Boiler labor.
- Producer labor.
- Engine labor.
- Electric labor.
- Fuel for steam.
- Fuel for producer gas.
- Water for steam power and gas.
- Water for hydraulic power.
- Lubricants for power.
- Production supplies.
- Station expense.
- Repairs of power plant buildings.
- Repairs of furnaces and boilers.
- Repairs of boiler apparatus.
- Repairs of steam accessories.
- Repairs of reciprocating engines.
- Repairs of steam turbines.
- Repairs of other steam engine equipment.
- Repairs of dams, canals and pipe lines.
- Repairs of turbines nad water-wheels.
- Repairs of gas producers and accessories.
- Repairs of gas engines.
- Repairs of electric generators.
- Repairs of accessory electric equipment.
- Repairs of station tools and implements.
- Repairs of miscellaneous station equipment.
- Steam from other sources.
- Power gas from other sources.
- Electric energy from other sources.

II. Transmission expenses.
- Transmission subway rent.
- Transmission pole and fixture repairs.
- Transmission underground conduit repairs.
- Overhead transmission system repairs.
- Underground transmission system repairs.

Substation labor.
Substation supplies and expenses.
Repairs of substation buildings.
Repairs of substation equipment.

III. Electric storage expenses.
Storage battery labor.
Storage battery supplies.
Storage battery renewals.
Repairs of storage battery accessories.

IV. Distribution expenses.
Electric distribution superintendence.
Electric distribution maps and records.
Electric distribution office expense.
Setting and removing meters and transformers.
Distribution subway rent.
Distribution pole and fixture repairs.
Distribution underground conduit repairs.
Overhead distribution system repairs.
Edison tube system repairs.
Other underground distribution system repairs.
Repairs of electric services.
Repairs of transformers.
Electric meter operation.
Electric meter repairs.

V. Utilization expenses.
Commercial arc labor.
Commercial arc supplies.
Commercial arc repairs.
Commercial incandescent installation.
Commercial incandescent renewals.
Inspection of consumers' premises.
Repairs of consumers' installations.
Municipal street arc labor.
Municipal street arc supplies.
Municipal street arc repairs.
Municipal street incandescent installation.
Municipal street incandescent renewals.
Municipal street incandescent repairs.

VI. Commercial expenses.
Commercial administration—electric.
Promotion office expense—electric.
Advertising—electric.
Canvassing and soliciting—electric.
Promotion wiring and devices.

VII. General and miscellaneous expenses.
Salaries and expenses of general officers.
Salaries and expenses of general office clerks.
General office supplies and expenses.
General law expenses.
Miscellaneous general expenses.
Insurance.
Relief department expenses.
Pensions.
Electric franchise requirements.
General amortization—electric.
Electric expenses transferred—Cr.
Joint operating expense—Cr.
Accidents and damages.
Law expenses connected with damages.
General stationery and printing.
Store expenses.
Stable expenses.
Undistributed adjustments—balance.
Duplicate electric charges—Cr.

TAXES.

Taxes.
Uncollectible electric bills.

NON-OPERATING REVENUES.

Rent accrued from lease of electric plant.
Miscellaneous rent revenues.
Interest revenues.
Dividend revenues.
Profits from operations of others.
Miscellaneous non-operating revenues.

NON-OPERATING REVENUE DEDUCTIONS.

Non-operating revenue deductions.
a. Rent expense.
b. Interest expense.
c. Dividend expense.
d. Others' operations expense.
e. Miscellaneous non-operating expense.
f. Non-operating taxes.
g. Uncollectible non-operating revenues.

INCOME DEDUCTIONS.

Interest deductions.
Rent for lease of other electric plant.
Joint facility rents.
Miscellaneous rent deductions.
Sinking fund accruals.
Guaranties of periodic payments.
Loss on operations of others.
Other contractual deductions from income.
Amortization of landed capital.
Amortization of debt discount and expense.
Amortization of premium on debt—Cr.

APPROPRIATION ACCOUNTS.

Bad debts collected.
Other additions to surplus.
Expenses elsewhere unprovided for.
Dividends on outstanding stocks.
Amortization elsewhere unprovided for.
Appropriations to reserves.
Gifts to controlled corporations.
Other appropriations.
Bad debts written off.
Other deductions from surplus.

The text of the account "general amortization—electric" is as follows:

"Charge to this account month by month the amount estimated to be necessary to cover such wear and tear and obsolescence and inadequacy as have accrued during the month in the tangible electric capital of the corporation, such portion of the life of intangible fixed capital as has expired or been consumed during the month, and the amount estimated to be necessary to provide a reserve to cover the cost of property destroyed by extraordinary casualties; less the amounts charged for that month to the various repair accounts in electric operating expenses. The amount charged (or credited) to this account shall be concurrently credited (or charged) to the reserve account 'accrued amortization of capital.'

"Note A.—Until otherwise ordered, the 'amount estimated to be necessary to cover such wear and tear and obsolescence and inadequacy as have accrued during' any month shall be based on a rule determined by the accounting corporation. Such rule may be derived from a consideration of the said corporation's history and experience during the preceding five years, and the accrual may be on the basis of kw-hours sold. Amortization of intangible capital shall likewise be based on rule. Whatever may be its basis, such rules and a sworn statement of the facts and expert opinions and estimates upon which they are based shall be filed with the Public Service Commission on or before Jan. 1, 1909; each amendment of any such rule and a sworn statement of the facts and expert opinions and estimates upon which such amendment is based shall be filed with the Public Service Commission before it is used by the accounting corporation, and shall show the date when it is to be effective. Such rules and statements shall be filed upon sheets 9½ in. x 12 in. and shall be entitled 'Rule of the (here naming the accounting corporation) concerning amortization of capital.'

"Note B.—When any capital is retired from service, the amount (estimated if not known) originally charged to a capital account in respect thereof shall be credited to such capital account, and (except as provided in account No. E100, 'fixed capital, Dec. 31, 1908'), the original money cost of such capital, less salvage, if any, shall be charged to the reserve account, 'accrued amortization of capital,' any necessary adjusting entry being made in the proper account under 'corporate surplus or deficit.' Where capital is substantially continuous and cannot be satisfactorily individualized, it shall be kept in efficient operating condition through repair, and the renewals and replacements of parts thereof shall be considered repairs. In the case of buildings, towers, bridges, trestles and other separate structures capable of being readily individualized, charges to this account must be sufficient to provide (in respect of such capital and except as provided in account 'fixed capital, Dec. 31, 1908'), in the account 'accrued amortization of capital' by the time such structures go out of service a reserve equal to the original money cost thereof, less salvage, to which account such original cost, less salvage, shall be charged."

Electric Railway Operations in Massachusetts.

Returns of the electric railways of Massachusetts now on file with the Railroad Commission of that State for the year ending Sept. 30, 1908, show that the 10 largest companies had combined gross earnings of about $26,739,000 compared with an income of $4,000 less in the preceding year. Through careful operation and the introduction of economies in the different systems, the operating expenses were reduced from about $17,830,000 to $17,607,000, leaving a gain in net for the year of approximately $500,000. The companies considered are the Boston Elevated, the Massachusetts Electric Companies, the Worcester, Springfield, Holyoke, New Bedford, Newton, Berkshire, and Boston and Worcester systems.

The combined capitalization of the 10 largest companies is about $44,000,000. The dividends declared were about $2,351,000, or an average of 5.3 per cent. These companies operated 1860 miles of track, giving gross earnings on the average of $14,400 per mile. There are about 2800 miles of electric railway track in the State. The gross earnings of the individual companies varied from a maximum of $14,000,000 in the Boston Elevated to a minimum of $371,000 in the Newton system. The surplus of all 10 for the year was about $212,000. Three companies paid 8 per cent, two paid 6 per cent, one 5.5 per cent, two 5 per cent, one 4 per cent, and one paid no dividends.

The Boston Elevated carried 273,000,000 revenue passengers, and ran 61,660,000 car-miles. The company had 8146 employees.

At the other end of the scale the Newton company carried nearly 8,000,000 passengers, employed 220 persons, and ran about 1,500,000 car-miles. Most of the companies ran a lower car mileage by a few per cent, but the effects of the financial depression are less drastic than in many lines of industry. The gross earnings per mile of track varied from $34,500 in the Boston system to $5,870 in the Berkshire, with corresponding net earnings of $11,300 and $1,580. The cost of power for the operation of these 10 roads was over $3,000,000, the Boston system requiring about half the expenditure. The gross earnings per car-mile varied from 23.4 cents to 29.7 cents; the net earnings per car-mile varied from 6.4 cents to 14.7 cents; the cost of wages devoted to transportation was 4.18 cents to 7.9 cents; the power cost was 1.86 cents per car-mile to 4.7 cents; and the cost of rolling stock repairs varied from 1.26 cents to 2.98 cents per car-mile.

Thowless Glow Lamp.

A patent was issued Nov. 24 to Orlando M. Thowless on a glow lamp of which the glower is a composite body made of a mixture of conducting and non-conducting material surrounded partially or completely with a body of which the material, though normally non-conductive, becomes conductive when heated and subjected to the action of an electric current. One form illustrated consists of a rod within a cylinder, but not in contact therewith. The rod is called the heating body and is made of a mixture of non-conductors, such as oxide of magnesium or aluminum, and a conductor, such as carbon or a conducting metallic oxide, all in a state of fine subdivision, the proportions being such that the heating body will be of high resistance as compared with carbon and yet be a conductor to the desired extent. Good results are obtained by a mixture of 10 parts of carbon and about 90 parts of oxide of magnesium. The surrounding cylinder, called the lighting body, is formed of a mixture of refractory metallic oxides, such as a mixture of zirconium, thorium and aluminum oxides. When the current is sent through the heating body, heat is developed therein and communicated to the lighting body to such an extent that it becomes a conductor of electricity and consequently incandescent. The luminous portion has the property of giving out a great amount of light with a comparatively small current, thus forming a very economical and efficient illuminant. The heating body and lighting body are connected in parallel, and when the latter becomes conductive it acts as a shunt for the current. The glower may be enclosed in a bulb exhausted of gas or containing indifferent gases, or it may be operated in the open air.

Submarine Cable Rates.

The campaign in Great Britain for reduced cable rates is increasing in activity. Mr. Henniker Heaton, M.P., the leader of the movement, is now agitating for the call of a conference of all of the postmasters-general of Europe, and a conference with the postal and administrative authorities of the United States, with a view to reducing telegraphic and cable rates. The facts to be presented to the latter are that the carrying capacity of the cables to America is equal to 12 times their present service, that their control is monopolistic and that the present rate of a shilling a word is excessive. The matter of reduced cable rates has been brought before the British House of Commons, the eventual aim being to secure a rate of two cents per word. As bearing on the question, Mr. Lemieux, postmaster-general of Canada, states that the announcement of the creation of the British Pacific Cable Company reduced the rates of the Eastern cables from $2.24 to $1.05 a word, and the opening of the line causes a further reduction to 72 cents a word. He favored a governmental cable system between England and Canada, which he believed would bring about a reduction of the cable rate not only from 25 to 9 cents a word, the ratio of reduction in the above-mentioned case, but in all probability a reduction to five cents per word or even less.

Seattle Section, A. I. E. E.

On Saturday, Nov. 21, about 40 members of the American Institute of Electrical Engineers of the Seattle section made a trip of inspection to the automatic Home Telephone Company, of Tacoma, Wash., instead of holding a regular monthly meeting, this constituting the regular annual excursion of the section and combining business with pleasure. The trip to Tacoma was made on the steamer *Indianapolis* and a pleasant dinner was enjoyed on board. The invitation was from President Wiggs, of the Home Company, and the members were met at the dock and escorted to the exchange, where they spent two hours profitably investigating the operation and construction of the automatic station. The return trip to Seattle was made by the Seattle-Tacoma interurban.

In the Seattle section of the A. I. E. E. there are about 45 members and in the State of Washington about 100 members. The branches in Washington are constantly growing in both size and influence. The officers of the Seattle section are: Mr. John Harrisberger, superintendent of Seattle-Tacoma Power Company, chairman; Mr. George H. Moore, secretary, and Mr. W. H. Hopkins, treasurer. Meetings are held the third Saturday of every month at the Chamber of Commerce, Lowman Building, Seattle.

CURRENT NEWS AND NOTES.

HELPER FOR ELECTRICIAN.—The U. S. Civil Service Commission will hold an examination on Jan. 13 for an electrician's helper in the office of the Secretary of the Department of Agriculture, Washington, D. C. The salary is $50 per month. Successful candidates are eligible for similar positions as they occur. Details can be obtained from the commission, Washington, D. C.

TUNGSTEN LAMP POLICY IN CHICAGO.—The Commonwealth Edison Company has just adopted the policy of allowing its ordinary carbon-filament lamps, upon which it furnishes free renewals, to be turned in by consumers for credit on the cost of new tungsten lamps, when consumers desire tungsten lamps instead of carbon-filament lamps. Thus a consumer turning in to the company one of the company's regular carbon-filament lamps will be given a tungsten lamp of 40 watts for 70 cents, of 60 watts for 90 cents, and of 100 watts for $1.10.

DEVELOPMENT AT MONTREAL.—With regard to proposed development by the Montreal Light, Heat & Power Company, of Montreal, Canada, which has enjoyed a remarkable growth, Vice-President Walbank writes us as follows: "This company is at present preparing plans for an additional 100,000-hp plant for future needs. In explanation thereof, we have at present 12,000 hp or 15,000 hp of peak load, which lasts only three months of the year, and then only for about an hour. It does not pay us to supply this power by water. We are therefore considering the installation of a steam plant to take care of this peak, and will probably put it in in instalments of, say, 10,000 hp or 15,000 hp as occasion arises." The plans have not yet been worked out fully.

OWNERSHIP OF NEW YORK CITY ELECTRIC LIGHTING PLANTS.—The annual report of the New York City Public Service Commission states that of the 25 corporations furnishing gas and electricity in that city there are only four companies that are nominally independent, of which only one, the Bronx Gas & Electric Company, supplies electrical service. The Consolidated Gas Company owns directly companies supplying 70.48 per cent of the gas and 75.93 per cent of electricity generated. Allied systems and companies supply 28.05 and 22.74 per cent respectively, the independent companies supplying only 1.47 and 1.33 per cent respectively. The report shows that there are 84,474 consumers of electric light and power in New York City.

ISTHMIAN CANAL ELECTRICAL PLANT.—The first installment of electrical machinery for the Gatun handling plant, Isthmus of Panama, has arrived on the Isthmus. It is expected the plant will be in operation by July 1, 1909.

SHEFFIELD SCIENTIFIC SCHOOL.—Mr. F. W. Vanderbilt has given $50,000 to the Sheffield Scientific School of Yale University to be used for building dormitories on Sheffield Square. Mr. Vanderbilt is a graduate of the class of 1876.

SIX THOUSAND-HP INDUCTION MOTORS STARTED.—One of the four 6000-hp General Electric alternating-current induction motors in the rail mill of the United States Steel Corporation, at Gary, Ind., was started successfully Nov. 29.

ELECTROTECHNIC CLUB.—A meeting of the Electrotechnic Club, which is composed principally of employees of the Fort Wayne Electric Works, at Fort Wayne, Ind., was held in that city Dec. 1. Prof. J. W. Esterline, of Purdue University, addressed the meeting on the subject of "Commercial Testing of Raw Materials," dealing principally with materials employed in the construction of electrical apparatus.

GAS EXPOSITION.—The Gas Appliance Exposition is being held this week at the First Regiment Armory, Chicago, Dec. 7-12, under the auspices of the National Commercial Gas Association and the American Gas Institute. On Dec. 10 the Gas Association will entertain the Chicago section of the Illuminating Engineering Society at the Armory, and after dinner Mr. Cressy Morrison, member, will deliver an address on "The Advance in the Gas Lighting Industry."

FORESTRY AT UNIVERSITY OF MONTANA.—The University of Montana will shortly institute a course in forestry in the School of Engineering, of which Prof. Nathaniel R. Craighill is dean. The U. S. government has selected Missoula, the seat of the university, as the headquarters for a forestry division with Mr. F. C. Greeley as chief, and the officials attached will co-operate in organizing and conducting the forestry course, which will be made strong from the engineering side.

CONSOLIDATION OF EDISON PHONOGRAPH MANUFACTURING INTERESTS.—The National Phonograph Company has announced that the manufacture of all Edison phonographs and records will hereafter be concentrated at West Orange, and that even the factories of London, Paris and Berlin will no longer be utilized for this purpose. While original records will be made abroad as heretofore, the manifolding of these will be done exclusively in the West Orange plant.

OPPOSE TRAIN DISPATCHING BY TELEPHONE.—It is reported from Indianapolis, Ind., that the local branch of the Order of Railway Telegraphers will try to obtain legislation in that State to prevent train dispatching by telephone, on the ground that the method is unsafe, unreliable and a menace to the lines of employees and the traveling public. Telephones are now being used on more than 6000 miles of railroad in this country and this method of dispatching trains has been approved by the American Railway Association.

NEW YORK ELECTRICAL SOCIETY.—The next meeting of the New York Electrical Society will be held in the Singer Building, 149 Broadway, New York, at 8 p. m., Wednesday, Dec. 16. An address on the subject of the Singer Building will be given by Mr. Charles G. Armstrong, who was associated in the engineering work of the structure. The address will be illustrated by lantern slides. After the address the members will be conducted through the plant and up to the summit of the tower.

A. S M. E.—The American Society of Mechanical Engineers held a highly successful convention in New York City last week, which was largely attended. The address by Major Squier, acting chief signal officer, and Lieutenant Lahm's lecture, both on aeronautics, attracted widespread attention. Mr. Jesse M. Smith, the president-elect, of whom a biographical sketch appears in this issue, is well known in the electrical field.

NEW HAVEN ELECTRIFICATION.—At the meeting of the American Institute of Electrical Engineers, on Dec. 11, at the Engineering Societies Building, New York City, Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, will read a paper entitled "The Log of the New Haven Electrification." The following engineers are expected to take part in the discussion: Messrs. W. J. Wilgus, George Gibbs, B. J. Arnold, N. W. Storer, B. G. Lamme, Calvert Townley, L. B. Stillwell and Ralph D. Mershon.

CONSUMPTION OF ELECTRICITY.—To prove that the use of electricity is safer than gas, a local firm of electrical engineers presents the following comparisons based on the report of the Massachusetts Gas and Electric Commissioners for the June 30, 1907, fiscal year and the record of the Boston Underwriters:

	Gas.	Electric light.
Consumers in Massachusetts	2,425,644	2,531,074
Fatal accidents to the public	53	1
Non-fatal to public	54	2
Fire loss	291	17

It will surprise most people, probably, to find that there are more consumers of electricity than of gas in the State.

SMOKELESS BUFFALO.—Buffalo as she would appear if electric power were used exclusively is to be one of the main features of the Industrial Exhibition which the Manufacturers' Club of that city has arranged to be held in Convention Hall, Dec. 14 to 19. Almost all the space has been allotted to local manufacturers, who are to install working exhibits to demonstrate the varied and extensive lines of industrial in Buffalo, and to increase the interest of her citizens in the consumption of goods "made in Buffalo." The decorations are designed to be a prophecy of Buffalo busy, but smokeless, to show that a city can be busy without polluting the air, and that this condition is especially possible in Buffalo by electric power. The booths will be so equipped as to create the general effect of the representative industries of the city being run at full blast, but without a particle of smoke. The Manufacturers' Club aims to help bring about an era of cheaper electricity.

THE ELECTRICAL CONGRESS.—The Congress of the International Electrotechnical Commission has finished its labors. Delegates were present from Canada, Denmark, England, France, Germany, Hungary, Japan, etc. The United States were not officially represented, owing to some misunderstanding, but unofficially Mr. C. O. Mailloux, a visitor, was a most efficient substitute, and his knowledge of languages stood the congress in good stead. The permanent bureau of the organization is in London, with Mr. Le Maistre as permanent and Colonel Crompton as honorary secretaries. Prof. Elihu Thomson was unanimously elected president, as successor to Lord Kelvin and M. Mascart. In his absence, Sir John Gavey, of the general postoffice, occupied the chair, and the delegates were welcomed by Mr. A. J. Balfour, the leader of the Opposition in the House of Commons. The rules to govern the congress were unanimously adopted, as also was the general scope of a proposed glossary of terms to be universally employed, which will be compiled by collaboration between the local committees. The adoption of any photometric units was voted premature and postponed, and various points for future decision were referred to the same local committees. The German delegates invited the commission to meet in Berlin in 1910.

Substation of the Berlin Elevated & Underground Railway.

AN interesting converter substation has recently been erected in Berlin for supplying power to part of the Berlin Elevated & Underground Railway, and especially to its western extension.

This station, which is situated in Charlottenburg, a western suburb of Berlin, was designed for an equipment of 3300 kw, consisting of five 660-kw rotary converters.

A buffer storage battery having a rating of 888 ampere-hours on the one-hour basis, was provided for dealing with the very heavy momentary current demands incident to the operation of a metropolitan railway with high initial accelerations and frequent stoppages. As the voltage curve of the rotary converter is practically a straight line, the buffer battery would work under rather unfavorable conditions, both in charging and discharging, unless special means were provided. For this purpose use is made of two reversible battery buffers, designed on the Pirani system, one of which serves as reserve.

The electrical signaling system contemplated for Bismarckstrasse and Wilhelmplatz stations further necessitates the installation of two small rotary converters for 130 volts, direct current, in conjunction with two small storage batteries, carrying at the same time part of the lighting current load of the substation.

The substation is erected in the gradually widening space between the tunnels leading to Westend and Wilhelmplatz respectively, and a high-tension switchboard room, the machinery room proper, with the direct-current switchboard, a battery room and ventilating compartment and some accessory rooms.

The safety in operation of the high-tension switch-gear is insured by placing it in a separate room. All of the switches are operated from a distance, and transformers are used for all of the instruments. The available space allowed the safeguards necessitated by the various cables, transformers and converters, as well as the oil switches and measuring transformers, to be installed in separate self-contained cells.

After the ultimate completion of the station, four high-tension cables, starting from the new Westend power station, will be so connected by means of main and section switches to the three-phase busbars of the converter station as to allow each of these cables to feed energy independently to either one of two sets of converters. This arrangement was chosen with a view to avoiding any difficulty which might arise from working in parallel converters receiving energy from high-tension lines connected in parallel.

Two of the high-tension cables from Westend will be connected to separate short busbars, at which the two cables from Trebbinerstrasse at present terminate. This allows those cables to be used to supply three-phase energy either directly to the motor-generators of the Trebbinerstrasse station (eliminating the converter station) or else in parallel to the latter.

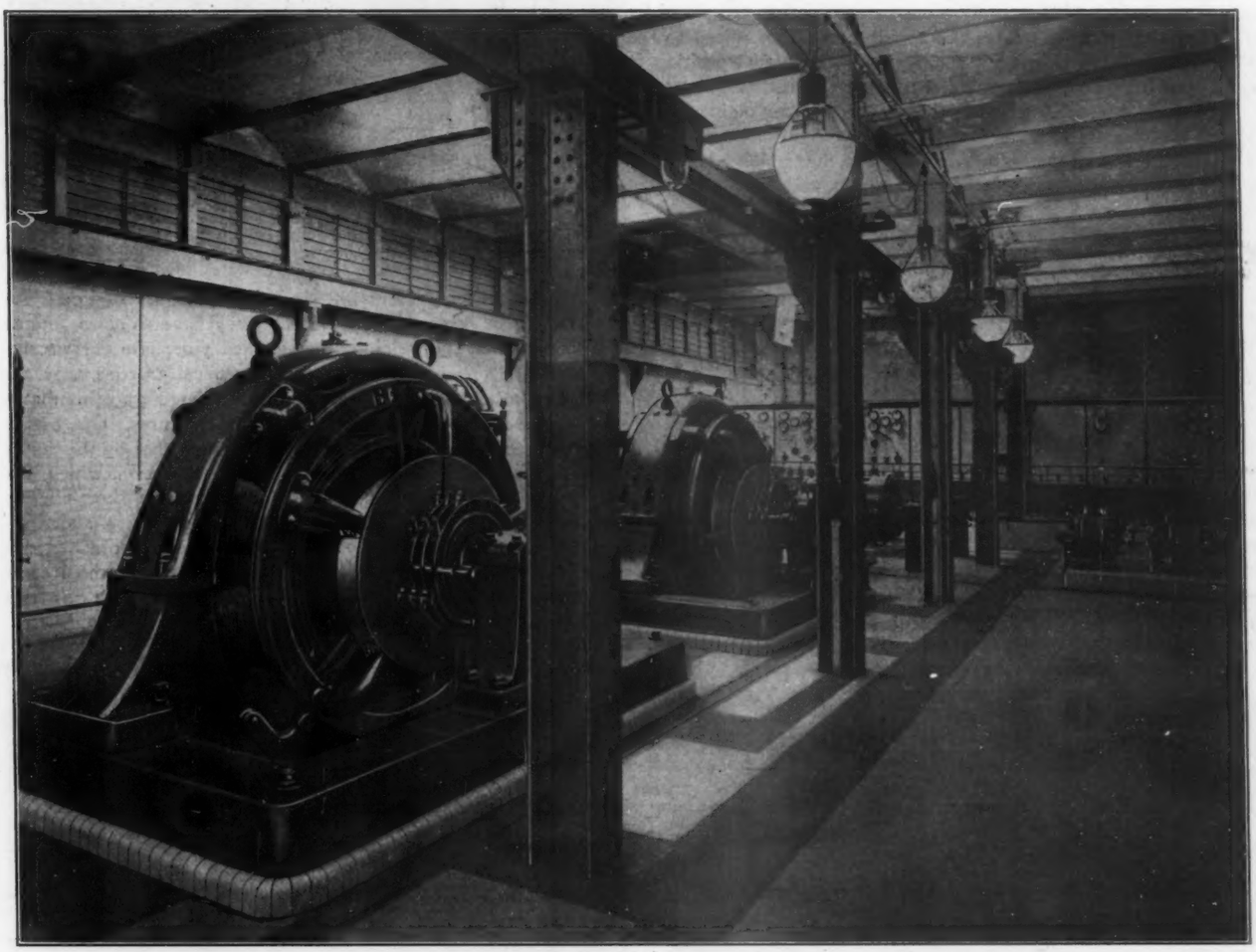


FIG. I.—SIX-PHASE ROTARY CONVERTERS, EACH PROVIDED WITH TWO COMMUTATORS.

In order to protect against excesses in voltage, six spark-gaps in star-triangle connection, with three-phase oil resistors, and a voltage-measuring transformer are connected to the intermediary busbars of the two individual cables, to be laid out later on.

Bare conductors carried by grooved porcelain insulators lead to the cable cell proper. Each cell, which consists of a profile iron frame, comprises in its lower part enclosed by concrete

walls the main cable-switch, made up of three single-pole oil switches; the upper compartment separated by wire mesh contains the motor gear of the switch, as well as the maximum relays and measuring transformers. Bare conductors connect the cell to the main busbars, whence the high-tension conductors are branched off to the transformers of each of the converters. The corresponding switching and measuring transformers are located in cells of a design similar to that of the cable cells; however, the three single-pole oil switches are replaced by a three-pole switch.

Fuses have been provided only in connection with the voltage-measuring transformers, while all the remaining high-tension circuits are protected exclusively by automatic overload circuit breakers with time-relays, which arrangement has given very good results. The long-distance operation of each of the oil switches is effected by a small direct-current motor, which turns a crank-shaft through a given angle by means of a friction-clutch worm and worm wheel, thus throwing the switch in or out of gear by the aid of a small rod.

The switching motor is controlled by a small switch on the main switchboard, any motion once started being completed by the motor, even in case the controlling switch is raised to the reverse position before its completion. The actual position is indicated by colored incandescent lamps in the neighborhood of the controller switch, and the automatic disengaging is also indicated by an alarm bell.

In addition to the switching cells for the cables and rotary converters, the high-tension switchroom contains two auxiliary

FIG. 2.—HIGH-TENSION SWITCHROOM.

transformers and their switching cells. The latter transformers are designed for 185 kv-amp, with a ratio of 10,000 to 500 volts, and supply the energy required for operating the auxiliary motors. The large number of switches allows the various switching cells, etc., to be separated from the busbars, and the latter to be subdivided as far as possible, thus enabling the supervision and cleaning of the different parts of the switchgear to be carried out without interrupting the service or giving rise to any danger.

Three conductor, high-tension cables similar to the measuring and controlling cables are carried alongside the outer wall of the engine house toward the main 850-kw transformers, which are installed near the rotary converters. The transformers, which are designed for water cooling, will reduce the e.m.f. of the energy from 10,000 to 570 volts. The low-tension windings are not interconnected, the two ends of each phase winding being carried out of the transformer toward the slip-ring of the corresponding rotary converter. In order to allow the tension to be controlled within certain limits, which is the more important, as several converter stations receive energy from a common station, with a variable drop in tension in the feeders, a certain amount of leakage was provided for in the transformers, which, owing to the variable exciting of the rotary converter, will enable the commutator e.m.f. to be altered within about 15 per cent.

The cooling of the transformers is obtained from water dropping down alongside the housing. While this arrangement requires the oil vessel to be given somewhat larger dimensions than in the case of cooling coils immersed in the oil, it was found preferable on account of the suspended matter in the cooling water and the large percentage of iron contained therein. Cooling coils would have required frequent thorough cleaning, which, owing to the space conditions, would have been felt as a decided inconvenience, whereas the outside walls of an oil vessel are readily cleaned during operation.

FIG. 3.—ARRANGEMENT OF HIGH-TENSION CABLES.

The rotary converters are six-phase machines designed for an output of 660 kw at 780 volts. They have 10 poles, and at a frequency of 40 cycles of the supplied polyphase current, revolve at 480 r.p.m. Contrary to the general practice, they are built as entirely symmetrical machines, possessing a commutator and three slip rings on each side of the armatures. One of the commutators is taken up by the plus and the other by the minus brushes, so as to insure an ample brush separation, which is a considerable advantage in view of the frequent short-circuits liable to occur on railway sections. In fact, such short-circuits, in spite of a quick-acting automatic circuit-breaker, are apt to result in an explosive arc surrounding the whole commutator of a machine of the usual design. Although any arcs produced are blown outside in an axial direction by electro-

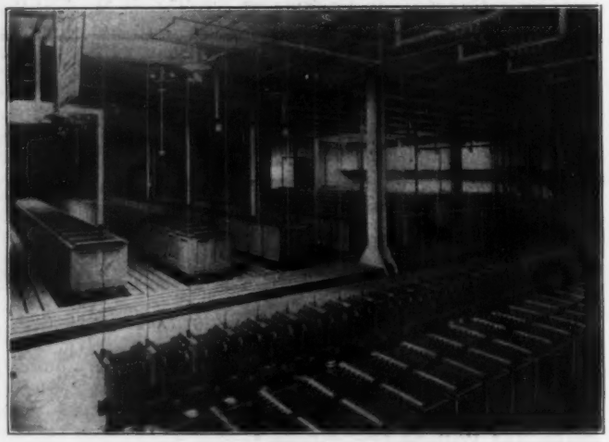


FIG. 4.—STORAGE-BATTERY ROOM.

magnetic effects, heavy injury may be incurred as a consequence of continued arcing. The arrangement above described has given very satisfactory results in operation.

The converters are started and synchronized at the direct current end with current obtained from the storage batteries.

The direct-current switchboard possesses some distinctive features, in so far as it has been mainly designed on the single-

pole plan, the grounded negative pole of the main engines being immediately connected through a section-switch placed close to the machine to the minus busbars laid out alongside the crane-runway support. This arrangement allows of a considerable saving of copper while reducing the number of switches, conductors, etc., placed on the switchboard.

Furthermore, there are no line conductors on the front of the switchboard; all direct-current switches and self-acting switches are arranged at the back, being controlled from the front through grounded gears. The commutators of one of the two Pirani battery buffers is inserted in the minus conductor of the battery; that is to say, it is connected to earth so

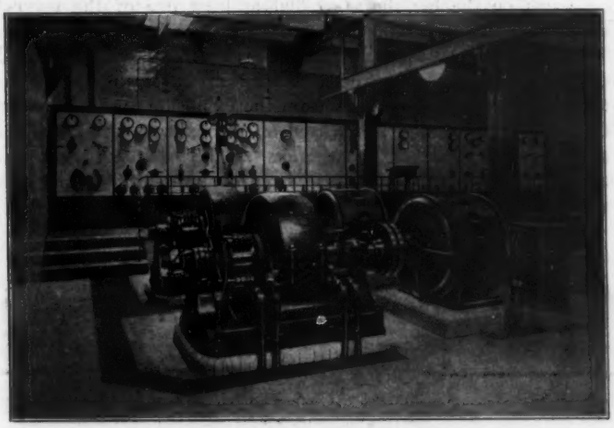


FIG. 5.—REVERSIBLE BATTERY BOOSTER.

as to make contact with it free from danger. The measuring instruments have insulating housings, and the current is supplied from the back, so as to make the operation of the switchboard, in spite of the relatively high tension of 780 volts, entirely free from danger.

There are three railway batteries—namely, one for the section leading to Knie station, another for the Wilhelmplatz section and a third one for the Westend section—each of which, whenever required, is connected by a switch situated behind the switchboard to an auxiliary panel with self-acting circuit-breaker and ammeter, so as to allow any breakdown in a feeding panel to be readily remedied.

As has been stated above, a reversible booster of the Pirani type has been inserted in series with the battery, with a view to insuring a satisfactory working together of the buffer bat-

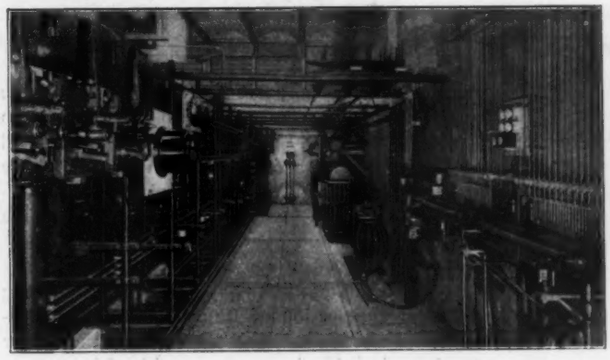


FIG. 6.—DIRECT-CURRENT SWITCHBOARD.

tery and the rotary converters. In the case of large machines, and especially of rotary converters, such alterations in voltage as are due to fluctuations in the load are quite immaterial, and the buffer battery, even in the case of considerable load variations, will be taken advantage of only relatively seldom. This drawback is remedied by the booster mentioned, which will work in the direction of a discharging or charging battery according as the load either exceeds the average output of the machine in course of working, or falls short of the latter.

The exciter current of the booster is supplied by a small exciter, which in the present case is fitted with separate drive, and the field cores of which are provided with two windings, namely, a shunt coil, traversed by a constant current and which produces an additional charging voltage, and a series coil traversed by a current proportional to the actual load on the system and which, acting in opposition to the former, will tend to produce a discharging voltage. The m.m.fs. of these two coils are so balanced in regard to one another as to compensate each other when the load on the system is equivalent to the average output of the machine. As soon as the load on the system increases it will produce a discharging voltage, and, as soon as it drops below the average generator output, a corresponding charging voltage.

By using a Pirani machine, the generators are thus kept at practically constant load, in spite of heavy fluctuations in the load on the system, while reducing within considerable limits any fluctuations in the busbar voltage.

The buffer battery supplied by the Akkumulatoren-Fabrik, Ltd., for a busbar e.m.f. of 780 volts, comprises 370,888-amp cells, the rating being on the basis of a one-hour discharge. Each cell comprises 12 positive and 13 negative plates. The arrangement of the accumulator compartment is such as to facilitate inspection, both the lighting and insulation of passages being very satisfactory.

The high-tension three-phase energy is transmitted by two triple-conductor cables with iron tape armoring. Each of the three conductors of those cables has a cross section of 70 square millimeters, and the insulation has been tested at 30,000 volts.

The Siemens-Schuckertwerke acted as contractors for the whole plant.

Gas-Engine Power Plant of the Union Switch & Signal Company.

As a result of the construction of a large foundry and a forge shop, the Union Switch & Signal Company found that the small steam engines and gas engines which heretofore comprised the power plant of its works at Swissvale, Pa., were inadequate for the demands arising from increased manufacturing facilities and it has therefore erected a new power station and equipped it with machinery having ample output for present and future requirements. As is well known, Swissvale is in the Pittsburgh district where natural gas abounds, so that a gas-engine plant would naturally be chosen. Anticipating,

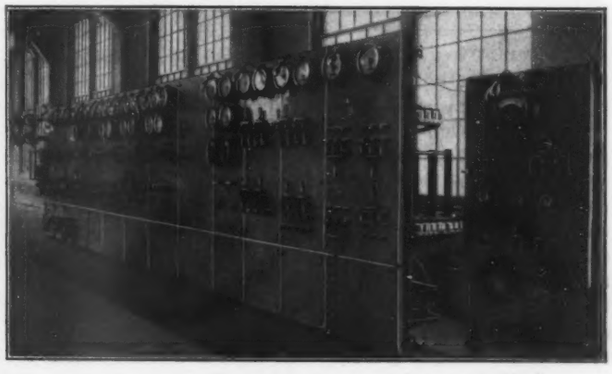


FIG. 1.—VIEW OF SWITCHBOARD.

however, a shortage in the natural supply, the engines installed were designed to operate also on producer gas and the piping connections were laid out with special reference to the use of producer gas at some future time, with natural gas connections for auxiliary supply. For the present, at least, no gas producers will be installed, the engines operating on natural gas.

The present equipment comprises three 500-hp, tandem-compound engines and two 125-hp units for night and auxiliary service. Space is provided for three large and three small

units so that the power plant will have a rating of 3500 hp when finally completed. At the north of the power house space is reserved for a gas-produced installation capable of supplying all the units with fuel. The power house adjoins the main line of the Pennsylvania Railroad. It is a single-story structure of brick and steel and has a clear head room under roof trusses of 24 ft. in addition to an 11-ft. basement, wherein are the piping connections and the foundations for the engines. A 15-ton, electrically-operated crane spans the engine room and a standard gage side track enters the building at floor level for delivery of freight to the power house.

The natural gas available has an average calorific value of 950 lb.-Fahr. units per cubic foot; but the engines are designed for operation on a comparatively lean producer gas and although normally rated at 500 hp are capable of carrying a load of 600 hp. The Westinghouse Machine Company built the engines, the large units being of the two-cylinder, double-acting, horizontal, tandem type each direct-connected to a 340-kw, two-phase, 60-cycle, 220-volt generator. The engines give two impulses per revolution and are fitted with 30-ton flywheels. The engines are of the side-crank construction with all valve motions operated from a lay shaft at the side of the bed frame. The functions of inlet, mixing and governor valves are combined in a single mechanism in the inlet valves and the ignition system is of the make-and-break type. No part of the ignition circuit passes through the frame of the engine and double insulated igniter plugs are used. Both the inlet and exhaust valves at either end of each cylinder are operated from the same eccentric and two igniters are fitted in cages at either end of the cylinder for convenience in removing and inspecting them. The igniters are operated from 110-volt, direct-current circuits and the inductance coils for each of the plug circuits are fitted with clapper armatures to serve as tell-tales for indicating proper action of the various igniters. The make-and-break actions are mechanically operated from a small auxiliary lay shaft parallel to and slightly above the main lay shaft and driven therefrom by a cross bevel-gear connection. The ignition circuits are run in iron conduit with cast-iron junction boxes, and each igniter circuit has a fuse as a protection from short circuits and grounds. The speed regulation of the engines is under the control of sensitive governors, which operate through oil-pressure relay cylinders having linkage connections to the inlet valve cut-off sleeves. Automatic safety stops, consisting of centrifugal plungers in the rims of the flywheels, are provided. These open the ignition circuit in case of excessive speed.

The two smaller units installed are of the single-acting, three-cylinder type and are direct-connected to 75-kw generators through flexible couplings. The engines embody the usual features of the Westinghouse vertical design, embracing throttle governing and mechanically operated make-and-break ignition. In addition to these units there is a small gasoline engine in the basement which is belted to an air compressor, the output of which is used for filling the compressed-air tank should the usual supply of compressed air fail.

All of the engines are started by compressed air. The larger engines have unbalanced poppet valves connecting into either end of each cylinder, which are located in relation to the knock-off cams on the lay shaft, so that at least one of the valves will be held open to admit air under pressure into the cylinder. The unbalanced valves will close unless held open by the knock-off cams which time the ignition so as to cause the engine to turn over. The air is admitted on the explosion stroke portion of the cycle only, and is released on the exhaust stroke. The air supply is obtained from tanks in the basement with an auxiliary supply from a steam-driven compressor located elsewhere about the works.

Forced feed lubrication is used for the cylinders, valve stem and rods, and all open bearings are lubricated by a gravity feed system. Water for cooling purposes is taken from a large reservoir primarily installed in connection with a fire protection system of which it forms a part. Water flows from an elevated tank connected to the sprinkler fire protection system to the cooling jackets of the engine and is discharged into the reservoir. An electrically operated pump delivers water from the reservoir to the overhead tank.

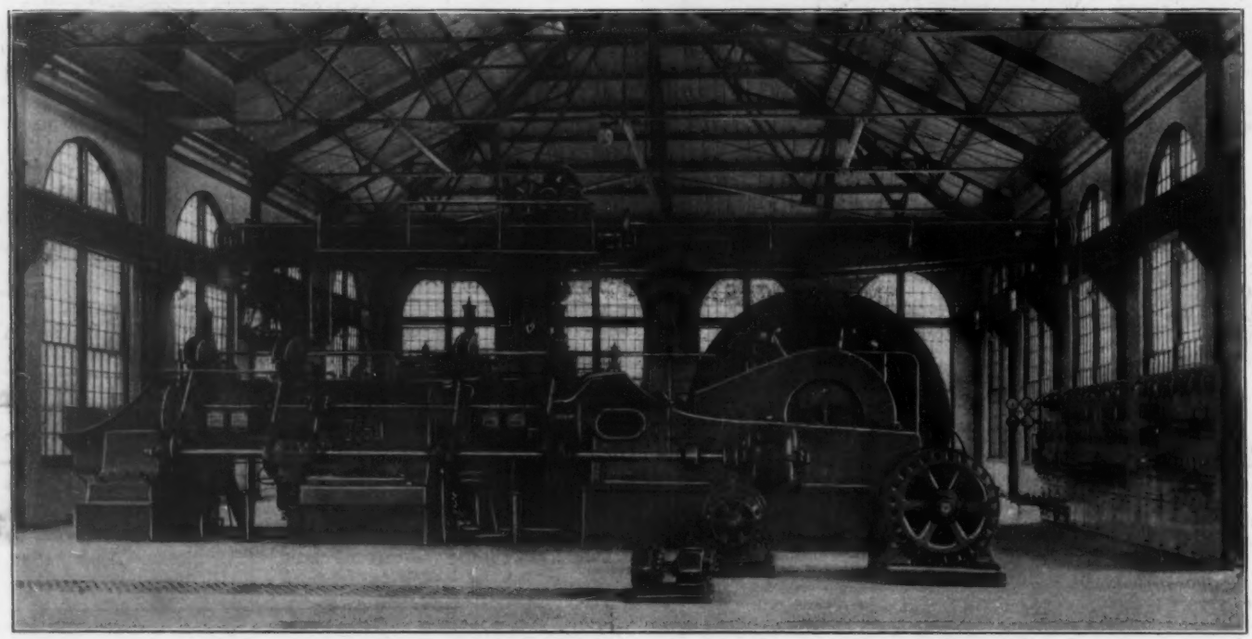


FIG. 2.—GENERAL VIEW OF INTERIOR OF GAS-ENGINE STATION, SWISSVALE.

The piping systems of the plant consist of a 5-in. natural gas line for present use, a 24-in. producer gas line with distributing gas tanks installed in anticipation of future operation on producer gas, and 16-in. air intake lines for each of the larger units. The natural gas is fed at low pressure with 36-in. gasometer-regulators delivering to the distributing gas tanks to which the future producer gas line is also connected. A natural gas connection is also provided to the future producer line which permits by-passing the gas supply to the latter. The gas and air branch connection to each of the large engines is a 10-in. line which leads to the manifold connections above the floor for the inlet valves. The exhaust piping consists of 8-in. connections from each of the exhaust valves to a 20-in. exhaust header arranged alongside of the engine foundation. Near the building wall the header is reduced to a 12-in. outlet.

Underground muffling chambers have been built into which the exhaust gases are discharged before they finally escape to the atmosphere. Double-hinged iron explosion doors are provided in each chamber which in case of possible back fire in the exhaust line open and relieve the pressure of the explosion.

The electrical equipment at present installed comprises three 340-kw alternators, two 75-kw alternators, a 75-kw and a 25-kw motor driven exciter set and two 5-kw exciters belted to the flywheels of the smaller units. The ignition circuits are supplied with energy from a duplicate set of motor-generators rated at 1 kw and wound for 110 volts.

All the bulky switchboard apparatus, such as rheostats for the generators and auto-starters for the motor-generator sets, are placed in the basement. Provision is made on the switchboard for indicating whether the auto-starters are in the open or in the starting position so as to insure against the switches on the main board being thrown in when the auto-starter is in running position. There are two distribution lines leading

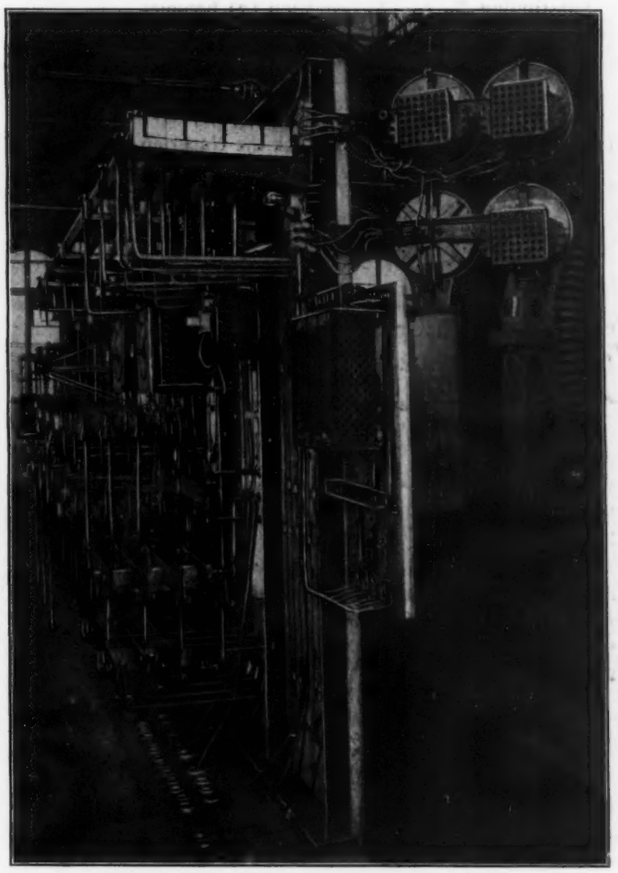


FIG. 3.—BACK OF SWITCHBOARD.

from the power station, one to a secondary switchboard in the carpenter shop of the old plant, from which all lamp and motor circuits in the old shops and offices are supplied, and the other to a secondary switchboard located at the center of distribution for the new shops.

The first distribution line comprises two lighting and eight motor circuits, all of which are placed in underground conduit. The lines running to the new forge shop are placed overhead on iron poles. Weather-proof cables having a cross-section of 500,000 cir. mils are used as feeders. On the wall back of the main switchboard there is a small panel which controls the circuits in the power station. For lighting the station Nernst lamps are used overhead on each span and a 16-cp incandescent lamp is placed on each column around the building and immediately under the crane runway rail.

There are 300 16-cp incandescent lamps and 10 Nernst lamps used for illuminating the offices, the corridors being lighted from four arc lamps and the drafting room being illuminated by 10 Cooper Hewitt lamps. In the shops there are 2700 incandescent lamps, 64 arc lamps and 62 Nernst lamps installed. The incandescent lamps are generally used around machines, the arc lamps in the middle of bays and the Nernst lamps in open floor spaces free from belting. In addition to the above the new foundry will be equipped with 15 Cooper Hewitt lamps and the forge shop will have 10 Cooper Hewitt lamps in circuit.

Before the erection of the new shops there were 78 motors, aggregating 1108 hp, in use. The present motor equipment, including that in the new shops, aggregates about 1400 hp. The average size of motors in use varies from 20 hp to 30 hp, the largest motor being rated at 100 hp and the smallest being rated at 1 hp. The 100-hp motor is direct-coupled to the centrifugal underwriters' pump. The power station as well as the extensions at Swissvale have been made under the supervision of Mr. J. G. Schroeder, chief engineer of the Union Switch & Signal Company. The Westinghouse Companies contracted for the power equipment.

The Short-Period Carrying Capacity of Cables.

BY WM. A. DEL MAR.

The current which a conductor will carry steadily for an indefinite period has been calculated and determined experimentally in scores of ways and under practically every condition met with in practice, but the writer is not aware of any determination of the momentary carrying capacity of conductors other than fuses. The necessity of having this information in order to determine the proper size of cables for traction purposes, led to the investigation described below.

The formula derived should not be used without understanding the assumptions made in deriving it; for although they are quite reasonable under ordinary conditions, they do not necessarily hold under certain extreme conditions. These assumptions are as follows:

(1) That the heat dissipated by the cable is directly proportional to the temperature rise.

(2) That the specific heat of the conductor and insulation does not vary greatly over the temperature range considered, an average value being assumed.

(3) That the cable insulation is raised to the same temperature as the conductor. This assumption is only approximately correct for thin insulation on large cables; cables smaller than No. 00 B. & S., or insulated for over 1000 volts, not being in this class. This restriction is of little moment, however, as the important use of the formula is in connection with large power cables, a knowledge of the carrying capacity of which may lead to considerable economy of copper.

The following formula gives the time (t = minutes) during which a cable will carry I amperes with a temperature rise of D deg. Fahr.

$$t = 40.5\ PAKGZ$$

P, A, K and G are constants of the cable and are defined as follows:

P = [(specific heat of conductor × weight in pounds per foot) + (specific heat of insulation × weight in pounds per foot)].

A = cross-sectional area of cable in circ. mils.

K = average of the reciprocals of the ohms per mil-foot over the range of temperature considered. For practical purposes, AK is the reciprocal of the resistance per foot of the cable at the temperature midway between the initial and final temperatures assumed.

$G = \frac{F}{I^2}$, where F is the final temperature rise which would occur with I amperes applied steadily. It is a constant for every cable under given conditions of thermal exposure, and may be obtained from the values of F and I given in the numerous tables published.

Z is a function of $\frac{D}{GI^2}$, and when the latter is known, may be taken from Table I or calculated by the formula

$$Z = -\log\left(1 - \frac{D}{GI^2}\right),$$

the logarithm being to the base 10.

The product, 40.5 $PAKG$, which is a constant for a given cable under given conditions, is the time in minutes required to raise the temperature of the cable to 90 per cent of its final temperature rise.

The watts generated in a cable on account of its ohmic resistance are partly absorbed by the cable and partly dissipated from it.

The joules absorbed when the temperature is raised D deg. Fahr., equal pD, where $p = 1055$ [(specific heat of conductor × its weight in pounds per foot) + (specific heat of insulation × its weight in pounds per foot)]. Hence, the watts absorbed equal

$$p\frac{dD}{dt},$$

t being the time in seconds.

The watts dissipated per foot of cable when the temperature rise is D deg. Fahr. are equal to

$$qD,$$

q being the watts dissipated per foot per degree temperature rise.

Then, if W = watts generated per foot of cable,

W = watts absorbed + watts dissipated

$$= p\frac{dD}{dt} + qD \qquad (1)$$

The temperature of the cable rises until the watts dissipated equal the watts generated, so that when

$D = F$, the final temperature rise,

$$qD = W$$

or

$$F = \frac{W}{q}$$

Equation (1) may then be written

$$\frac{W}{q} = \frac{p}{q}\frac{dD}{dt} + D = F,$$

whence,

$$\frac{dt}{dD} = \frac{p}{q} \cdot \frac{1}{F-D}$$

$$\therefore dt = \frac{p}{q} \cdot \frac{dD}{F-D}$$

$$\therefore t = \frac{p}{q} \cdot \log_e \frac{F}{F-D} \qquad (2)$$

The F in the numerator is the constant of integration and is determined from the condition that when $D = 0$, t must be zero. As $F = \frac{W}{q}$, and $W = I^2r$, where r is the resistance of the cable in ohms per foot,

$$F = \frac{I^2r}{q}$$

and

$$\frac{F}{I^2} = \frac{r}{q}$$

which is a constant and may be called G.

Substituting $\frac{G}{r}$ for $\frac{1}{q}$, equation (2) becomes

$$t = \frac{pG}{r}\log_e\left(1 - \frac{GI^2}{D}\right) \qquad (3)$$

Reducing to minutes, replacing p by P, which is $\frac{p}{1055}$, and substituting common logarithms for the Naperian,

$$t = 40.5\,\frac{GP}{r}\log\left(1 - \frac{GI^2}{D}\right) \qquad (4)$$

Writing Z for the logarithm, the equation becomes,

$$t = 40.5\,\frac{GP}{r}\,Z \qquad (3)$$

The above deduction is based on the assumption that r is constant. As, however, r varies with the temperature, the time, t, will be proportional to the mean value of $\frac{1}{r}$. Hence, we write,

$$\frac{1}{r} = AK,$$

where A is the cross-sectional area in circ. mils and K is the mean of the reciprocal of the ohms per mil-foot over the temperature range considered. Hence, equation (3) reduces to,

$$t = 40.5\,PAKGZ. \qquad (4)$$

The equation considered above connects the variables t and I, D being constant. The same equation, however, may be used to express the relation between t and D, I being maintained constant, and for this purpose is most conveniently written

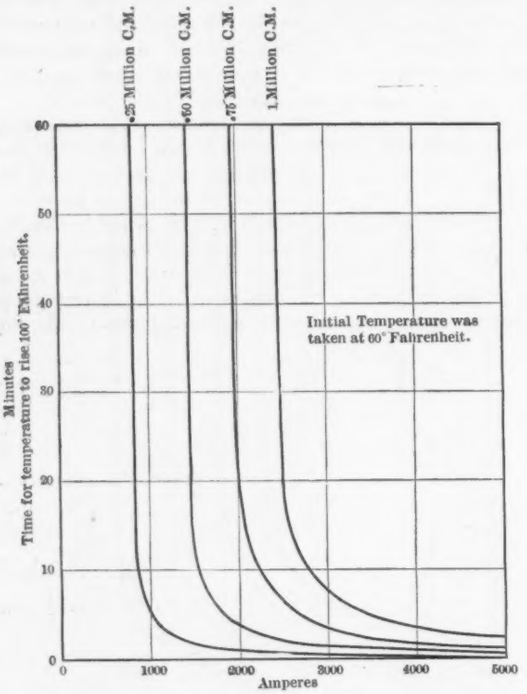
$$t = 40.5\,PAK\,\frac{F}{I^2}\,Z$$

where $Z = \log_{10}\left(1 - \frac{F}{D}\right)$ and F is the final temperature rise with I amperes applied indefinitely.

Experiments on the time element of fuses by Schwartz and James, detailed in the *Journal* of the Institution of Electrical Engineers, July, 1908, page 71, may be accurately represented by this equation, although a range of 180 Fahrenheit degrees is covered. Thus, with an enclosed fuse consisting of a No. 27 S. W. G. copper wire surrounded by Calais sand in a ½-in. fiber tube, the temperature rise is represented by

$$t = 20\,Z,$$

the current being 20 amp.



CURVES OF TEMPERATURE RISE OF BARE COPPER CABLES IN THE OPEN AIR.

TIME ELEMENT OF FUSES.

The numerous curves representing the experiments of A. Schwartz and W. H. N. James, which are published in the paper referred to above, may be represented, very closely, by the equation

$$t = 40.5\ PAKGZ,$$

if the constant 40.5 $PAKG$ be found from one point on the curve. The constant cannot be calculated because there is no way of determining how much heat is absorbed by the filling and terminals.

If, therefore, the continuous carrying capacity and the carrying capacity for a definite time are known, the carrying capacity for all periods may be calculated. In other words, the characteristics of a fuse may be completely represented by a statement of its continuous fusing current and of its factor Q, the time in minutes it takes to rise to 90 deg. of the temperature rise required for fusion, which is equal to

$$40.5\ PAKG.$$

Thus, a No. 27 S. W. G. copper wire in the open air has a normal fusing current of about 20 amp and a factor Q equal to 0.15, t being in minutes. This completely describes the characteristics of the fuse.

SHORT-PERIOD CARRYING CAPACITY OF RAIL BONDS.

The size of rail bonds is usually settled on the basis of conductivity, but the bond resistance forms such a small proportion of the total resistance that the conductivity is really of little importance. Thus, a line composed of 30-ft. rails bonded with 18-in. bonds, having half the conductance of the rail, has a

TABLE I.—VALUES OF Z.

$\frac{D}{GI^2}=\frac{D}{F}$	Z	$\frac{D}{GI^2}=\frac{D}{F}$	Z	$\frac{D}{GI^2}=\frac{D}{F}$	Z
0.005	0.00218				
0.01	0.00436	0.31	0.161	0.61	0.409
0.02	0.00877	0.32	0.167	0.62	0.420
0.03	0.0132	0.33	0.174	0.63	0.432
0.04	0.0177	0.34	0.180	0.64	0.444
0.05	0.0223	0.35	0.187	0.65	0.456
0.06	0.0269	0.36	0.194	0.66	0.469
0.07	0.0315	0.37	0.201	0.67	0.481
0.08	0.0362	0.38	0.208	0.68	0.495
0.09	0.0410	0.39	0.215	0.69	0.509
0.10	0.0458	0.40	0.222	0.70	0.523
0.11	0.0506	0.41	0.229	0.71	0.538
0.12	0.0555	0.42	0.237	0.72	0.553
0.13	0.0605	0.43	0.244	0.73	0.569
0.14	0.0655	0.44	0.252	0.74	0.585
0.15	0.0706	0.45	0.260	0.75	0.602
0.16	0.0757	0.46	0.268	0.76	0.620
0.17	0.0809	0.47	0.276	0.77	0.638
0.18	0.0861	0.48	0.284	0.78	0.658
0.19	0.0915	0.49	0.292	0.79	0.678
0.20	0.0969	0.50	0.301	0.80	0.699
0.21	0.102	0.51	0.310	0.81	0.721
0.22	0.108	0.52	0.319	0.82	0.745
0.23	0.113	0.53	0.328	0.83	0.770
0.24	0.119	0.54	0.337	0.84	0.795
0.25	0.125	0.55	0.347	0.85	0.824
0.26	0.131	0.56	0.357	0.86	0.854
0.27	0.137	0.57	0.367	0.87	0.886
0.28	0.142	0.58	0.377	0.88	0.921
0.29	0.149	0.59	0.387	0.89	0.959
0.30	0.155	0.60	0.398	0.90	1.000

TABLE II.—VALUES OF P FOR BARE COPPER CABLES.

Specific heat = .093.

Size.	No. of Strands.	P.
2 million C.M.	127	.558
1½	91	.425
1¼	91	.354
1	61	.284
¾	61	.212
½	61	.142
¼	37	.0709
0000 B. & S.	19	.0600
000 B. & S.	19	.0476

For aluminum of the same resistance, increase P by 11 per cent.

TABLE III.—RECIPROCALS OF OHMS PER MIL-FOOT.

Deg. Fahr.	Reciprocal of Ohms per Mil-Ft.	Deg. Fahr.	Reciprocal of Ohms per Mil-Ft.
50	.0980	100	.0883
55	.0970	105	.0874
60	.0960	110	.0866
65	.0950	115	.0858
70	.0940	120	.0850
75	.0930	125	.0842
80	.0920	130	.0833
85	.0910	135	.0826
90	.0900	140	.0818
95	.0892	145	.0811
100	.0883	150	.0804

The above table is based on 98 per cent conductivity.

conductance 95½ per cent of that of a continuous rail without joints. The size of rail bond should therefore be determined by its carrying capacity and mechanical strength, and it is the short-period carrying capacity of the bond which is important.

The formula under consideration seems well adapted to give the required information as soon as the values of Q for different conditions have been experimentally determined.

The writer regrets that he is not in a position to give his formula a thorough experimental test, and hopes that others having the necessary equipment will take up the work.

The Mechanical Equivalent of Light.

By J. S. Dow.

A considerable amount of attention has recently been devoted to one question that goes to the very root of the theory of light-production—namely, what is the ultimate limiting efficiency that we can hope to secure?

The figures bearing on this subject that have been obtained in the past have varied very considerably. An interesting collection of such results, supplemented by redeterminations of his own, has recently been published by Dr. C. V. Drysdale,[1] who gives a value for the mechanical equivalent of white light (arc) of 0.08 watt per candle-power. Dr. H. Lux[2] has likewise contributed a resumé of his own experiments on this point, giving values of the radiant efficiency of a large number of sources of light, and the derived values of the mechanical equivalent. He finds that the result obtained varies very much in the case of different sources, in many cases departing somewhat widely from those of Dr. Drysdale.

As Dr. Drysdale explains, the discrepancies of observers in the past may be largely accounted for by certain misconceptions as to the absorption of the optical apparatus used in such determinations, and to differences in definition, etc. The writer wishes to point out, however, that there still seems to remain a number of points on which more rigid definition is required before we can hope for consistency. That there is still room for considerable difference of opinion on these questions is shown by the suggestion attributed to Dr. Steinmetz, that the

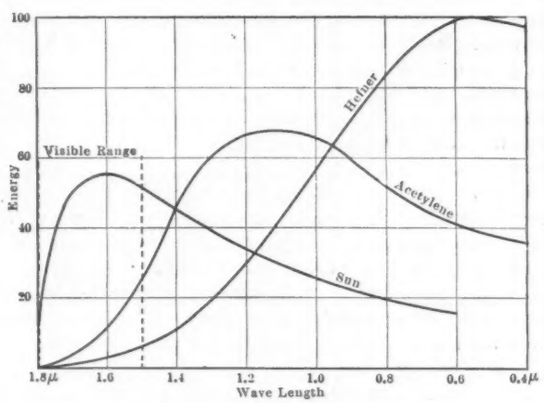


FIG. I.—ENERGY CURVES OF ILLUMINANTS.

mechanical equivalent for white light is in reality in the neighborhood of 0.02 watt per candle-power (50 cp per watt).

The efficiency of incandescent illuminants is, of course, now recognized to be very dependent upon the temperature of incandescence. In most practical cases the vast majority of the radiant energy is still expended outside the visible range of the spectrum, but a small increase in temperature has the effect of shifting the maximum of the energy-curve a little nearer to the useful luminous region, and of enormously increasing the efficiency. It would seem, however, that the limit of improvement by this means is reached when the maximum is located over the central region of the visible range of the spectrum, and there is reason to believe that, even in this case, the efficiency would still be relatively low.

The ideal source, for ordinary practical purposes, would apparently be one, which, like the firefly, yields a spectrum that is continuous but whose radiation is yet confined to the visible form. In one sense the efficiency of such an illuminant might be described as 100 per cent, for all the energy produced would emerge in a luminous state. However, a little consideration makes it clear that more efficient conditions, as regards brightness, are conceivable. For the radiation within the prescribed limits, though all visible, is not all equally useful as regards

[1] *Illuminating Engineer*, London, August, 1908.
[2] *Illuminating Engineer*, London, February, 1908.

luminosity. The results of many observers enable one to locate the most useful portion of the spectrum (at ordinary bright illuminations) as lying within the yellow-green, though the exact point of maximum efficiency may still be regarded as not definitely settled; the light in the extreme red and violet regions of the spectrum is naturally of little use for the purpose of "creating brightness."

The fact just mentioned is one that seems to be partially responsible for the discrepancies on the part of different observers in studying the mechanical equivalent of light. The limits assumed for the visible spectrum, in making the determination, are very vital. It is clear that the mechanical equivalent of light will depend upon this factor, and a small alteration in the limits of radiation that is regarded as luminous may enormously increase the energy included without very materially affecting the light, . . . especially if, as is usually the case with incandescent solids, the energy gradually becomes concentrated as the infra-red end of the spectrum is approached.

Even when certain limits of wave length are agreed upon, the radiant efficiency, and therefore also the mechanical equivalent of light, must depend on the quality of the radiation within the range accepted. Therefore, one should naturally expect determinations of the mechanical equivalent of light to differ in the case of different illuminants, and it is not surprising to learn that Lux (loc. cit.) finds the mechanical equivalent to be 0.103 watt per hefner-candle for the acetylene flame, 0.047 watt per hefner for the direct-current arc lamp, and 0.14 watt per hefner in the case of the Uviol mercury lamp. A glance at Fig. 1, where the writer has reproduced the energy curves of the radiation of the sun, the hefner lamp, and the acetylene flame respectively,[8] suggests an explanation of such differences; one can readily understand that, even in the case of a continuous spectrum, the energy may be heaped up to a greater or less extent on the borderland of visibility and so may increase the total energy without greatly increasing the total amount of light.

This in itself seems sufficient to explain the results referred to above. Rightly defined, the mechanical equivalent of light is expressed in terms of the physiological effect upon the eye of a certain amount of radiant energy and it would seem that, provided the wave-length of this energy is specified, it is immaterial how this energy has been generated; that is, whether by pure thermal incandescence or by the aid of selective radiation.

A source of light intended for ordinary purposes of illumination ought to enable colors to be distinguished with fair accuracy and hence a continuous spectrum is desirable. What we are chiefly concerned with, therefore, is the value of the mechanical equivalent for "white light." Yet, as explained above, owing to the distribution of energy in the spectra of illuminants that are commonly regarded as "white"—for example, the light from an arc lamp, an incandescent mantle, daylight, or an osram lamp—the mechanical equivalent will probably be found to differ considerably in the various cases. For physiological reasons there seems cause to advocate the adoption of a theoretical standard distribution of energy, producing, as nearly as possible, a light that exactly resembles average daylight illumination, as a definition of white light.

However, it is also clear that for many purposes we are not anxious to secure a continuous spectrum. In a lighthouse, for instance, one might probably be willing to sacrifice color-definition, and to be content with even a monochromatic light, provided he could gain in efficiency of producing brightness by so doing; in such a case the inefficient red and violet rays might be ranked with the invisible heat-radiation as undesirable and not worth production. Other cases might be cited in which the generation of light of a strictly monochromatic character is permissible.

It is important, therefore, to decide exactly what kind of light is required for certain purposes. In the present article, however, the writer proposes only to consider what will generally be admitted to be the most important quality of light—namely, the "power of creating brightness."

Dr. C. V. Drysdale has distinguished between the mechanical equivalent of white light and that of yellow-green light near $\lambda = 0.54\,\mu$, which he assumes to be the point of maximum efficiency. He finds the mechanical equivalent in the two cases to be 0.0805 watt and 0.0598 watt per candle respectively, values which differ to some extent from those of previous observers and also, though to a less degree, from those of Dr. Lux.

It may, however, be questioned whether this is really the point of maximum sensibility, and if so, under what conditions. Here we are faced at once by the physiological difficulties that invariably assail one when considering the effect of light of different colors on the eye.

It seems to be recognized now that two distinct conditions of the eye exist, and that the curve of spectral intensity has been modified accordingly. At high illuminations the maximum luminosity is stated to be situated near 0.58 μ to 0.59 μ in the case of white light; at low illuminations, on the other hand, the maximum occurs near 0.525 μ according to Abney, Koenig, and many other investigators. The exact position of both these points, however, seems to depend on the order of illumination specified and the region of the retina employed, possibly, on the previous history of the eye. (For a record of some such curves and the changes that occur at various orders of illumination, see also Nutting, Electrical World, June 27, 1908.) For the purpose of reference two such characteristic curves are shown in Fig. 2. According to the modern theories of physiological optics these two conditions of the eye correspond to the

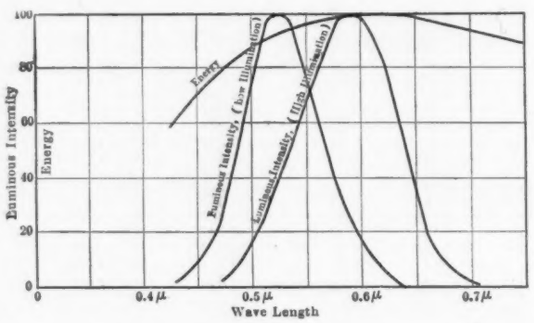


FIG. 2.—LUMINOUS INTENSITY CURVES.

predominance of two entirely distinct systems of light-percipient organs on the retina, known as the "rods" and the "cones" respectively.

It may be pointed out, therefore, that, even when dealing with sources of light that are approximately "white," and in determining the value of the mechanical equivalent for light of this nature, two distinct results may be obtained corresponding to these distinct physiological conditions, while naturally intermediate results may be possible if we strike the order of illumination corresponding to the borderland of action of these two sets of organs; naturally, too, the region of the retina and the relative proportions of rods and cones existing thereon, may also be an important factor.

Our determination of the mechanical equivalent is based upon the photometric comparison of the light investigated and some standard source, usually of different spectral composition; as explained above, the quality of the radiation in the two cases may be widely different without the actual color of the light yielded by them being so very divergent. Nevertheless a change in physiological perception so profound as that shown in Fig. 2 can hardly fail to lead to discrepancies among results obtained at different orders of illumination.

A glance at Fig. 2 suggests that the portion of the spectrum which is valuable at high illuminations may not be that which is of use when the illumination is exceedingly low, say, under 0.2 lux. Information on the bearing of these facts on ordinary illuminants is still meager.

However, when we turn to pure monochromatic colors and

[8] Dr. L. Bell before the Illuminating Engineering Society, June 8, 1906.

seek to achieve their comparison, and thus to obtain the mechanical equivalent in different regions of the spectrum, the more or less arbitrary nature of the result becomes yet more evident. Fig. 2 by itself suggests that the "cheapest variety of light" must be very different in the two cases, and it is also a fact that the size of the illuminated surface plays a much more important part in deciding the result at these weak illuminations.

Yet, even in the case of the comparison of pure colors, the shape of the luminosity-curve seems pretty well defined, *provided it be understood that one is dealing with reasonably high illuminations* of the order of, say, 10 foot-candles and upward. Under these conditions a maximum near a wave length of 0.58 μ to 0.59 μ seems to be accepted for the conventional white light. It is true that, even under these circumstances, the influence of the rods would seem to be still potent, for photometrical results appear to depend to some extent upon the angle of vision and the region of the retina employed in vision. However, the luminosity of the central region is so overwhelmingly great in comparison with that of the extremities of the spectrum that considerable discrepancies might occur in the determination of the values of the brightness in the red and violet without materially affecting the general nature of the curve.

It may be of interest, therefore, to attempt to form some idea of the value of the mechanical equivalent of light in different regions of the spectrum at normal high illuminations. With this object in view the writer has added to the two luminosity curves in Fig. 2, which closely approximate to those of sunlight, the energy curve of solar radiation as determined by Nichols.[1] By dividing the ordinates of the luminosity curves by the corresponding ordinates of the energy curve we obtain two new curves of relative luminous efficiency. It will readily be seen that these two curves would closely resemble the luminosity curves in Fig. 2 and their maxima occur at practically the same points; therefore, the author has not thought it necessary to reproduce them, although they have been made the basis of the calculation in this article. If, therefore, the value of the mechanical equivalent is accurately known for any particular wave length, it is an easy matter to calculate its value in any other position in the spectrum from these data.

It may be repeated, however, that the results depend very much on the nature of the energy curve of the solar radiation obtained; as is well known, the determination of the exact position of the maxima of such curves is attended with some difficulty, and it is conceivable that an exact study of the luminosity and energy curves of other illuminants might lead to apparently different conclusions. This problem again calls for more exact study and a complete and absolutely satisfactory determination of the values of the mechanical equivalent for light of various colors has yet to be made. Nutting has published the following figures on this subject:[2]

TABLE I.—VALUES FROM NUTTING'S DATA.

Wave length in .001 mm.	Candles per watt.
0.620	3.1
0.556	12.1
0.566	13.5
0.595	11.8

One may, however, work out a rough estimate of the mechanical equivalent of light of different wave lengths from the data obtained, by utilizing the latest figures of Dr. Drysdale, for light of wave length 0.54μ. This value is given as 0.598 watt per candle, which to all intents and purposes may be regarded as 0.06. It will be seen that, if the curves of luminous efficiency obtained above can be regarded as correct, this is not the wave length corresponding to high-illumination maximum efficiency, being, indeed, intermediate between the two limiting conditions corresponding to the two states of the eye. It is stated, however, that the illumination of the photometric surfaces used in determining this value was one foot-candle, and the writer's experience suggests that, provided the field of view subtended a fairly small angle at the eye, this value of illumination is probably sufficiently high to enable us to apply it to the curve representing the state of affairs at high luminosities. In the absence of a monochromatic determination that is definitely known to be applicable to the low-illumination curve, the writer forbears from attempting to deduce the mechanical equivalent under these circumstances. In order to obtain the desired results for the curve representing vision at high illuminations, however, we have only to assume the value 0.06 for the ordinate at 0.54 μ and reduce the other ordinates of the curve correspondingly. By so doing the following table is obtained:

TABLE II.—MECHANICAL EQUIVALENT OF LIGHT FOR VARIOUS REGIONS OF THE SPECTRUM (CALCULATED FROM THEORETICAL CURVES OF LUMINOUS EFFICIENCY BY THE AID OF DR. DRYSDALE'S VALUE FOR LIGHT AT 0.54 μ).

Wave length in .001 mm.	Mechanical equivalent.	
	Watts per candle.	Candles per watt.
0.45	4.0	0.25
0.475	0.66	1.5
0.50	0.21	4.8
0.51	0.14	7.2
0.52	0.102	9.8
0.53	0.075	13.3
0.54	0.06	16.6
0.55	0.053	18.8
0.56	0.0455	22.0
0.57	0.041	24.3
0.58	0.0375	26.7
0.59	0.0365	27.5
0.60	0.0375	27.3
0.61	0.038	26.5
0.62	0.041	24.3
0.63	0.0485	20.5
0.64	0.051	13.8
0.65	0.14	7.0
0.675	0.435	2.3
0.70	2.00	0.5

There are certain conclusions that are suggested by these figures, though, for reasons that have already been indicated, and for others that will be stated shortly, it seems best to regard them as *only* suggestive in the absence of more complete data. It might, however, be supposed that, at high illuminations, and in cases in which color-definition was not of material consequence, one should endeavor to concentrate the energy in the neighborhood of 0.58 μ or 0.59 μ; on the other hand, in cases in which only a very weak general illumination can be afforded, for example, for the lighting of the less important streets of a town, etc., presumably, the energy in the neighborhood of 0.52 μ or 0.53 μ should be strengthened, for this is now the region of the spectrum that appears to be most useful and the energy in the neighborhood of 0.59 μ is now of relatively small value for the purpose of illumination.

But it may be pointed out that these conclusions are open to question for at least one very interesting reason. So far as one is justified in applying these results it may be urged that the efficiency of any region of the spectrum, *considered separately*, is distributed as stated. However, it is not self-evident that they can be applied, without modification, to the treatment of illuminants whose action on the eye depends on the combined effect of more or less of all regions of the entire spectrum, acting simultaneously. Are we, in fact, justified in assuming that the luminosity curves of an illuminant, as usually obtained, correctly represent the values of the different portions of the spectrum when acting conjointly? And is it permissible to assume that the result of combining the impressions produced by light of two distinct colors will be equal to the sum of their separate effects?

This conclusion seems to have been reached by several of the physicists and physiologists who have approached the question —for instance, Rood, Abney, and Hering. Yet many of the experiments on which these results rest were carried out before the full development of the theory of the rods and cones, and in the light of this theory it is legitimate to ask whether the same conclusion would be arrived at at high and low orders of illumination, and especially on the borderland between rod-vision and cone-vision. Moreover, several cases have been recorded in which practical photometrical work seems to have suggested the existence of discrepancies pointing to an opposite conclusion, and it is certainly a matter which, in the interests of photometry, is one that deserves careful scientific study.

The question has been revived several times in connection

[1] *Trans.* Illum. Eng. Soc., May, 1908.
[2] ELECTRICAL WORLD, June 27, 1908.

with the photometry of the mercury arc. For instance, Mr. Bastian, who attempted to improve the color of this lamp by the addition of carbon-filament lamps, came to the conclusion that an unaccountable gain in luminosity was secured by so doing.[1]

A similar experience was once recorded by Professor Shaad.[2] He arranged to illuminate a room either by means of distributed glow lamps or by mercury lamps, or by both systems of lighting simultaneously.

The illumination from the carbon lamps alone was 1.1 foot-candles, and that from the mercury lamps alone was 2.2 foot-candles. The illumination yielded by both together worked out to 4.5 foot-candles, a value much higher than the illumination due to the sources separately would suggest.

It is, of course, necessary to exercise special caution in drawing conclusions from such experiments involving the complicated questions of color. It is, for instance, essential for the proper treatment of the subject that the same region of the retina should be used throughout, and there are other details which, if they do not receive careful attention, might produce an impression of the type referred to. The order of illumination specified in the tests of Professor Shaad, however, and other conditions existing in these tests, seem favorable to the restriction of the possibilities of uncertainty from the cause suggested, and (unless an explanation of the phenomenon has been arrived at since the date of publication of this paper), the matter would certainly seem to deserve further study.

Now, a study of the curve of luminous efficiency might throw some evidence upon the above question. If the effects of different regions of the spectrum are strictly additive, we might expect to find that the mechanical equivalent for white light would be the mean value, as deduced by integration of the curve between the assigned limits.

As pointed out above, it is conceivable that different answers to the question under consideration might be obtained from the curves corresponding to rod- and cone-vision, but, unfortunately, the available data for the former hardly justify one in attempting to apply the test in this case. By treating the curve of high-illumination luminous efficiency derived, from the energy and luminosity curves in Fig. 2, the writer has deduced a value for white light between the limits of 0.39 μ and 0.76 μ, as prescribed by Dr. Drysdale; the value works out to be 0.103 watt per candle. Had the limits 0.45 μ to 0.70 μ, which contain all that is really of much practical value from the point of view of luminosity in the spectrum, been assumed, the result would have been 0.078 watt per candle.

In conclusion the author desires to repeat that the numerical results put forward in this article are necessarily open to modification; his chief aim has been to suggest a few of the physiological difficulties surrounding the complicated but important scientific determinations of the efficiency of light-production, and to draw attention to a few possible lines of research on which further additions to the available data seem desirable.

English Municipal Central Station.

The London *Electrician* gives an abstract of last year's report of the West Ham municipal central station. In spite of its very energetic policy there has again been a deficit. The generating cost per kw-hour sold was 1 cent (against 1.18 cents the year before); the distributing cost, 0.30 cent (against 0.32); the management cost, 0.36 cent (against 0.42); the capital charge, 1.22 cents (against 1.38); the total cost was, therefore, 2.88 cents (against 3.30). The total receipts from all sources per kw-hour were only 2.68 cents. The number of kw-hours generated during the year was 13,340,948; of these 11,299,783 were sold, 2,123,336 being for private lamps, 4,161,156 for private motors and heaters, 790,180 for public lamps and 4,225,111 for tramways.

[1] London *Electrician*, Vol. 57, p. 131, 1906.
[2] *Trans.* Illum. Eng. Soc., May, 1907, p. 295.

Commutation of the Compensated-Series-Repulsion Motor.

By A. R. Dennington.

The causes of sparking in direct-current motors have been studied and remedies have been suggested and applied until in present practice it is possible to construct a motor that will give satisfactory operation at normal loads, and even with heavy overloads, without requiring any adjustment of the brushes and without showing any effects of sparking. In a direct-current motor the only cause for sparking is the breaking of the current due to the e.m.f. inductively produced in the coils short-circuited by the brushes. The e.m.f. thus produced in the coil is due to the reversal of the direction of current, and is increased by any condition which increases the magnetic flux produced by the current in the coil. The short-circuit self-induced e.m.f. will be increased by a decrease in the air-gap, a decrease in the reluctance of the armature teeth, an increase in depth of slot and decrease in width, a reduction in the winding-pitch so that the sides of the coil lie under the pole tips, and the current will be increased by a reduction of the resistance in the short-circuit path.

The frequency of reversal, and consequently the inductively produced e.m.f., varies with the speed, and at zero speed there is no current in the short-circuited coil of a direct-current armature. It is therefore evident that the induced e.m.f. can be completely overcome at all speeds by having the sides of the short-circuited coil located in a field of the proper strength and direction. The strength of the commutating field must vary with the current in the armature, because, other things remaining constant, the induced e.m.f. varies with the amount of current, and a field which will successfully neutralize it for one condition will be entirely inadequate for another. This fact will indicate that if commutating poles are used, the material must be worked at such a density that magnetic saturation will not take place with less than full-load current. Commutating poles may be provided in each neutral space, or there may be only half as many commutating poles as there are field poles. In the latter case the field must be strong enough so that the movement of the conductors on one side of the coil will set up sufficient pressure to neutralize that induced and give the correct value to the reversed current. The width of the commutating pole should be such that the sides of the coil pass from the commutating field when the bars to which the coil is attached pass from under the brush.

With all commutator types of alternating-current motors the conditions necessary to sparkless commutation in the direct-current motor must be fulfilled, and in addition new problems are presented by the varying value of the current in the armature conductors and the reversal of the flux in the magnetic circuits.

When the armature is at rest, the current in the short-circuited coil is limited only by the impedance of the circuit composed of the coil and brush, assuming a certain frequency and value of the field flux. If the armature is rotating, the time during which a coil is under a brush is very short, and varies directly with the speed. As the number of commutator bars is ordinarily from 20 to 30 per field pole, and as a complete reversal of the current in the armature coil must take place during the time a commutator bar is under a brush, it is evident that the frequency of commutation at synchronous speed will be from 20 to 30 times the frequency of the current in the supply circuit, and the frequency of commutation at very low speeds may be equal to the frequency of the supply. A study of the conditions produced in the short-circuited coil by the varying frequency of commutation is interesting in illustrating clearly the difficulties which are encountered in the design of a satisfactory alternating-current motor. In Fig. 1 are shown the current-curve of the main armature circuit and the corresponding changes in current in the short-circuited coil when the speed is about 75 per cent of the synchronous speed. The e.m.f. of self-induction is greatest when

the current wave has its maximum value, and at this instant the effect of the transformer action is a minimum. As the main current nears its zero value, the rate of change of magnetism increases, and there is produced a greater transformer e.m.f., which tends to send a current around the coil in a certain direction. In order that there may be no sparking, the current in the short-circuited coil must change from the instantaneous value of the main current in one direction to a value nearly the same in the opposite direction. For example, in Fig. 1 the current must change from the value represented by *oa* to *ob*. If the value of the current is different from the values given, there will be sparking as the bar leaves the brush, due to the induced e.m.f. The e.m.f. produced in the short-circuited coil by the transformer action will tend to give a current differing from the instantaneous value of the main current, and hence there will be sparking. If commutating poles are provided, the movement of the conductors through this field, which is in time-phase with the main field, may be made properly to neutralize the e.m.f. of self-induction due to the reversal of current as in the case of a direct-current motor, but it cannot neutralize the transformer e.m.f., because the transformer e.m.f. is in time-quadrature with the commutating field. Under speed conditions the effect of the transformer e.m.f. is different in different coils, and in the worst case is very much less than when the armature is stationary, because, though the rate of change in flux while the coil is short-circuited is the same, the total change is only a very small part of the change during a complete cycle, and the self-induction of the coil prevents the current from rising to a

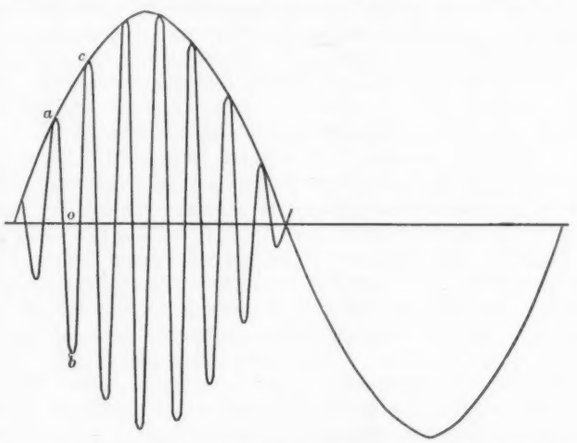


FIG. 1.—COMPARISON OF FREQUENCY OF COMMUTATION AND FREQUENCY OF MAIN CURRENT.

high value. The transformer e.m.f. will alternately aid and oppose the commutation of the working current, and at the instant the working current passes through zero the transformer e.m.f. is much in excess of the e.m.f. of self-induction, and at this instant the sparking is a maximum.

The sparking in practically all alternating-current series motors which have been introduced is reduced so the motors are suitable for the severe conditions of railway service by the use of (a) preventive resistance leads which oppose the current in the short-circuited coil by increasing the resistance of the circuit, or (b) by the use of a special winding which sets up a field in space quadrature to the main field, having the proper phase relation and strength to effectively neutralize the transformer and self-induced pressures, the effect of the transformer e.m.f. being reduced by the use of a fractional pitch armature winding.

The use of resistance in the commutator connections is open to the objection that it causes an increase in the armature resistance measured between brushes. However, the circuits are such that the main current traverses at least two commutator leads in parallel at each set of brushes while the short-circuit current must pass through two commutator leads in series. The opposition to the short-circuit current is thus four times the opposition to the main current, as is evident from an inspection of Fig. 2. The self-induction of the coil, by preventing the current from rising quickly to full value, will also tend to reduce the amount of current in the short-circuited coil when the armature is in motion. At standstill and at very low speeds, the resistance of the leads is the factor determining the maximum current in the coil undergoing com-

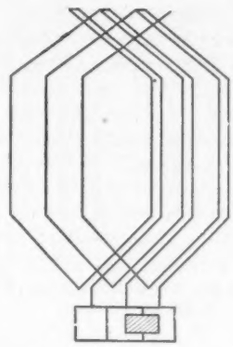


FIG. 2.—ARMATURE COILS WITH PREVENTIVE RESISTANCE LEADS.

mutation. The relations of the various e.m.fs. acting in the coil under commutation are shown in Fig. 3, where *OA* represents the transformer e.m.f. in time-phase. The e.m.f. of self-induction due to the transformer current will have a time-displacement of 90 deg. from the transformer current, as shown by *OB*. The e.m.f. of self-induction due to the reversal of the current in the short-circuited coil may have any time-phase whatever with respect to the other pressures mentioned, as the frequency is very much greater, and consequently it is represented on the diagram by a circle. There is also an e.m.f. due to the motion of the conductors through a magnetic field. This e.m.f. is in time-opposition to the e.m.f. self-induced by commutation of the main current, and may with proper field strength completely overcome it, leaving only *OA* and *OB* as component e.m.fs. The current *OI*, Fig. 3, lags behind the transformer e.m.f. which produces it on account of the reactance of the armature coils. Increasing the reactance of the armature coils by the use of narrow and deep slots, or any other method which will increase the leakage flux, will bring *OA* and *OB* more nearly into time-phase opposition, and will reduce the magnetizing current, and thus decrease the sparking, but never entirely eliminate it.

In the compensated-series-repulsion motor, the compensating windings are adjusted to have twice as many turns as there are turns on the armature, so that at starting, when the armature is short-circuited, normal current in the compensating winding will produce by transformer action nearly double current in the armature, thus affording increased starting torque. A fractional-pitch winding is used on the armature so as to bring both sides of the coil short-circuited by the

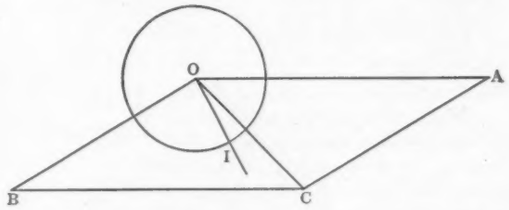


FIG. 3.—PHASE RELATIONS OF CURRENT AND PRESSURES IN SHORT-CIRCUITED COIL.

brush into a field of the same polarity. This arrangement will result in increasing the leakage flux of the short-circuited coil and increasing the self-induced pressure due to the reversal of the current. The compensating or inducing winding is not connected directly in series with the armature, but is so joined to the transformer that as the motor speed increases the compensating effect is reduced by manual operation. This result

is accomplished by connecting one terminal of the main winding and one terminal of the compensating winding to a common lead, which may be joined to various taps on the main transformer, while the other terminals of the two windings are connected to opposite ends of the working section of the transformer, Fig. 4.

As the pitch of the coil is less than the pole-pitch, the effective flux through the short-circuited coil is reduced. The field set up by the compensating winding lags in time-phase behind the field set up by the main winding and is in space-quadrature with it. The transformer component of the current in the short-circuited coil is in time-quadrature with the main flux and current. The component of the inducing field in time-phase with the main field should be great enough to overcome the armature m.m.f. and furnish a commutating field which will strengthen the trailing pole tip and weaken the leading pole tip and in this way maintain a potential difference between the sides of the short-circuited coil which will cause the reversal of the current. The component of the compensating field in space-quadrature with the main field may be

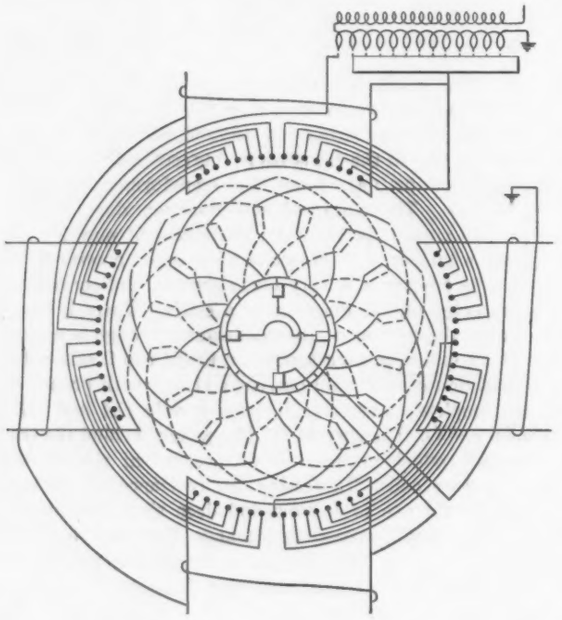


FIG. 4.—WINDING DIAGRAM OF COMPENSATED-SERIES REPULSION MOTOR.

made to compensate more or less completely for the transformer e.m.f. in the short-circuited coil.

In order to aid in the study of the action of this motor winding it is well to consider the process of commutation with direct current.

If the compensating winding is not included in the circuit, there is nothing unusual in the arrangement except that both sides of the short-circuited coil are under one pole. The pole will reduce the reluctance of the leakage path so that the induced pressure due to the reversal of the current will be greater than if full pitch were used. Any distortion of the field due to the armature m.m.f. will increase the short-circuit current by strengthening the field in which the lagging conductor moves and weakening the field in which the leading conductor moves. If the compensating winding is included, the armature reactions may be neutralized, and by a proper adjustment of the ampere-turns in the compensating winding there may be provided a field which will weaken the main field at the edge of the pole near the lagging conductor and strengthen it in the region of the leading conductor. The distortion of flux effected in this way will cause the conductors of the short-circuited coil to be in a field of the strength and direction necessary for the reversal of the current. The effect is the same as though separate commutating poles were used.

When alternating current is used, the armature is short-circuited at starting, and the inducing winding has maximum current in it. The armature current is produced by the transformer action of the compensating windings, which is provided with twice as many effective turns as the armature winding. The relations of the currents are shown in Fig. 5, where *OA* is the current in the main winding, *OB* is the current produced

FIG. 5.—PHASE RELATIONS OF CURRENTS IN COMPENSATED REPULSION MOTOR.

in the armature by transformer action, and *OC* is the current in the inducing winding. The inducing current is represented as nearly opposite in time-phase to the main current, on account of its direction in the winding. As the speed increases the angle *COA* will decrease, because current *OA* will come more nearly in time-phase with the pressure of the main transformer, due to the increased counter e.m.fs., while the current in the inducing winding will always lag behind the impressed pressure by a large angle. The figure clearly shows the large starting current which is obtained in the armature when only normal current exists in the main circuit. As the current in the main circuit is not large, the magnetic density in the field poles is not as great as it would be under ordinary starting conditions if the armature were not short-circuited, and hence the transformer e.m.f. is kept at a low value.

Under running conditions the short-circuit is removed from the armature and the strength of the inducing field is reduced manually as the speed is increased. The relations of the component armature currents and pressures are shown in Fig. 6, where *OA* is the main current, *OB* is the current produced by transformer action, *OE* is the transformer e.m.f., *OF* is the speed-generated e.m.f. due to cutting the compensating field, and *OG* is the component of *OF* opposed to *OE*. An inspection of the diagram shows that the special inducing winding provides in the short-circuited coil an e.m.f. which neutralizes almost completely the transformer e.m.f. when the armature is in motion. The inducing field is not in time-phase with either the main field or the transformer e.m.f., but it may be considered as being made up of two components; one produces a pressure opposed to the transformer e.m.f., and the other a pressure opposed to the self-induced e.m.f. due to commutation. The connections to the inducing-field winding are so adjusted manually as to give approximately the required flux at the various speeds. An increase in the main current will reduce the reactance of the inducing windings, as the armature windings may be considered as a transformer sec-

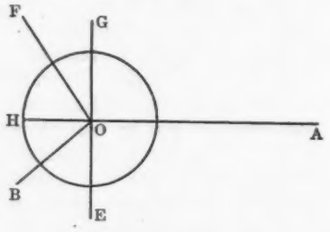


FIG. 6.—PHASE RELATIONS UNDER RUNNING CONDITIONS.

ondary, and hence more current will exist in the inducing winding. However, the flux will depend upon the e.m.f. between the terminals of the inducing winding. If the inducing winding and the main winding are connected in series, the transformer e.m.f. cannot be neutralized, and there will be practically the same conditions as are shown in Fig. 3. The current due to the transformer e.m.f. will be smaller than with a full-pitch

armature winding, because the coil which is connected to the brush does not surround the total flux from one pole, and also because the self-induction of the coil will be greater, so that the current cannot rise as rapidly to a large value.

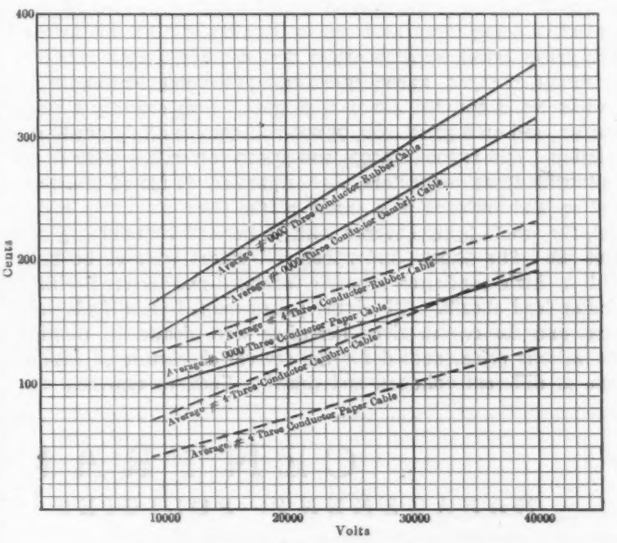
The resulting sparking due to uncompensated e.m.fs., which produce currents in the short-circuited coil, is not great enough to cause serious trouble. The commutators of series alternating-current motors may be caused to assume a high polish like the commutators of direct-current motors when in good condition. The greatest danger lies in the possibility of the motor armature remaining at standstill and having the uncompensated transformer current overheat the armature insulation, even though the e.m.f. supplied to the motor terminals is not great enough to produce an excessive current. For this reason series alternating-current motors should be proportioned so as to start the load quickly, or if this is not possible, it is necessary for the motorman to understand the conditions thoroughly, so that he will not allow the motor to remain in circuit for more than a few seconds if the machine does not start.

Cost of High-Tension Underground Cables.

By Henry Floy.

The complete cost of a system for underground distribution of electrical energy is made up of two entirely independent components—one the cost of the excavation and subsurface construction, and the other the cost of the conductors properly insulated and mechanically protected. The type of subsurface structure varies from simply a trench in which the electrical cables are buried to fireproof conduits, embedded in cement, which connect manholes spaced perhaps 400 ft. or 500 ft. apart, the manholes being, in some cases, as large as a small room and costing several hundreds of dollars each. The proper type of underground structure varies for different installations, depending on the investment allowable, the protection required and the desirability of being able to withdraw cables without disturbing the surface of the ground. In American cities conditions more commonly require the construction of conduit systems, which are usually of bituminized wood-fiber or the more costly vitrified clay ducts, laid in Portland cement. Owing to the difference of opinion among engineers as to the proper depth below the surface conduit should be laid, the mixture of cement to be used, the thickness of the concrete walls enclosing the conduits, the difference in type and size of manholes, and the varied costs of excavation due to difficulties in local conditions, such as traffic, sewer, water and gas pipes, rock or water-soaked material, the cost of labor, and particularly the widely varying expense of similar work owing to the varying ability of those in charge, it is impracticable to obtain average figures for conduit construction cost. The only safe method of estimating the cost of conduit construction for any given locality is by comparison, item by item, with due allowance for differences, with costs in another given locality. On the other hand, the price of underground cables will be approximately the same at a given time, disregarding the easily ascertainable freight rates, in any part of the United States. The cost of high-tension cables will vary slightly from time to time depending on the price of materials and labor; but this variation will be considerably less than might be expected owing to the fact that the cost of the cable of a particular type is made up of different items, variations in the cost of which, more or less, offset one another. For example, the present base price of copper is, say, 14½ cents, the highest price having been 27 cents, and the market price of rubber is about $1.10 a pound, the highest price having been only $1.30 a pound; similarly, the price of lead at present is about 4½ cents per pound, the highest price having been 6 cents per pound; paper costs 8 cents per pound, having cost as high as 10 cents per pound; the cost of labor is about as high now as at any time, although the efficiency is somewhat better. From these figures it will be seen that for a foot of three-conductor 4-0 25,000-volt rubber-insulated cable, which at present prices contains about 28 cents of copper, 23 cents of lead and 140 cents of rubber, and allowing 79 cents per foot for labor and profit makes the total cost as 270 cents per foot; whereas, if the maximum prices given above are all used, the total cost is 326 cents per foot, or an increase of only 56 cents, or about 20 per cent, as between present prices and all of the maximum prices which have been reached.

The inside measurements of a vitrified duct of the larger size at present used is about 3½ in.; this dimension, therefore, determines about 3 in. as the maximum diameter of the cable that can be used, there, of course, being necessary some play to allow drawing in the cable. Another objection to exceeding the diameter of 3 in. if the cable is to be sheathed in lead, is that the leading machines at present available cannot handle a cable larger than about 3 in. and some mechanical difficulties develop in leading machines if larger diameters are attempted. Moreover, cables of greater diameter are apt to be very heavy, cumbersome and stiff, thus making them difficult to handle, particularly to draw in ducts, even if the ducts were made of larger cross-section. Considering a 4-0 conductor, which is one very commonly employed in high-tension underground work, it is found that even with the very highest development in the art thus far attained, it has not been possible to make a three-conductor leaded cable for 50,000-volt service and keep the outside diameter of it



COST OF HIGH-TENSION UNDERGROUND CABLES.

down to 3 in. From these considerations, then, it is probable that cables for e.m.fs. of 50,000 volts and above, or even 40,000 volts and above, must be single-conductor, separately insulated, sheathed and installed, which means a very appreciable increase in cost as compared with a three-conductor cable enclosed in a single lead sheath. A compensating advantage, however, in the use of separately insulated conductors at the higher voltages is that fewer reserve conductors need be installed. For example, five single conductors would probably afford as much reserve insurance as two three-conductor cables, because, in case of a burn-out on a three-conductor cable, all three conductors may be damaged, so that a complete cable must be held in reserve; whereas, with single-conductor cables in separate ducts, one or two could burn out leaving the third for use with two other reserve conductors. Thus, in comparing the cost, for example, of 25,000-volt, 4-0 three-conductor cables and 50,000-volt, 4-0 single-conductor cables, there should be installed three of the single conductors for service and two as reserves; whereas, for the 25,000-volt service, transmitting the same amount of energy with the same loss, and ignoring some slightly increased dielectric and sheath losses in the higher voltage cables, there would be required four three-conductor cables, each having the same conductivity as the three single

cables designed for 50,000-volt service; and, in addition, perhaps two additional three-conductor cables for reserve, making a total of six three-conductor cables for 25,000 volts with only five single-conductor cables for 50,000-volt service for the same loss and approximately the same reserve capacity. For this case, it will be seen from the accompanying figures that the cost of the 50,000-volt cables will be less than that of the 25,000-volt installation, without considering the slight advantage of fewer ducts and less cost of drawing-in and connecting the cables.

Elaborate calculations have been made by certain engineers tending to show that, on account of the increased cost of insulation, with increased potentials, 25,000 volts is as high an e.m.f. as is commercially and financially economical to use in underground transmission. In order to check these theoretical conclusions, within the last few weeks, the writer has been investigating the cost of high-tension cables insulated with paper, cambric and rubber, and the so-called "graded" insulation, with the result that at prevailing prices very much higher than 25,000-volt underground service seems to be economical; and, for the reasons given above, such transmission is still likely to be commercially advisable, even with advances over present prices of insulating materials, lead and copper.

Bona fide quotations were secured from several of the largest and most reliable manufacturers of high-tension cables. As quotations were given about the first of October, it may be assumed that the prices named were based on the cost of raw materials, being about as given in the first part of this article. The prices asked were on cables designed for normal working potentials of 11,000, 25,000, 35,000 and 50,000 volts, with conductors of No. 4 and No. 4-0 B. & S. gage. Less recently a price was secured on a 50 sq. mm, 75,000-volt cable with "graded" insulation. The 11,000-, 25,000- and 35,000-volt cables were to be built with three conductors, each separately insulated and then laid up and enclosed in a jacket of the same insulating material, the whole being covered with ⅛-in. lead containing 3 per cent tin. The 50,000- and 75,000-volt cables were to be built with a single conductor properly insulated and covered with a similar lead sheath. All of the prices quoted were f.o.b. factory, and the curves given hereafter were drawn by plotting the various prices quoted for the several characters of insulation, at different voltages, and drawing lines, to represent the average, through the points as plotted, no allowance being made for transportation—a value easily ascertainable for any given locality—or for the cost of connecting and drawing the cables into ducts, which may be taken at from 8 cents to 10 cents per foot per cable. I assume it is fair to conclude that curves obtained in this way correctly indicate the cost of cables at intermediate voltage, which may be read from the curves.

TABLE I.—SPECIFICATIONS FOR THREE-CONDUCTOR CABLES WITH AVERAGE OF PRICES PER FOOT.

Each conductor separately insulated and laid up with jute fillers to make round, the whole covered with a jacket of insulating material, outside of which there is to be ⅛-in. lead sheath, lead to contain 3 per cent tin. No. 4-0 conductors to be stranded; No. 4 conductors to be solid. All cables to be tested for five minutes on twice normal working voltage, after installation.

	11,000-volt		25,000-volt		35,000-volt	
	No. 4.	No. 4-0.	No. 4.	No. 4-0.	No. 4.	No. 4-0.
Paper	$0.49	$1.03	$0.87	$1.47	$1.15	$1.76
Cambric	0.77	1.49	1.36	2.30	1.80	2.87
Rubber	1.30	1.78	1.80	2.66	2.16	3.30

TABLE II.—SPECIFICATIONS FOR THREE SINGLE-CONDUCTOR CABLES WITH AVERAGE OF PRICES PER FOOT.

Each single-conductor cable insulated and sheathed with ⅛-in. lead, lead to contain 3 per cent tin. No. 4-0 conductors to be stranded; No. 4 conductors to be solid. All cables to be tested for five minutes at twice normal working voltage, after installation.

	50,000-volt		75,000-volt
	three No. 4.	three No. 4-0.	three 50 sq. mm.
Paper	$3.18	$4.12	...
Graded	3.75	4.95	$6.78
Rubber	6.00	6.90	...

The prices submitted by the different manufacturers on the lower voltage cables did not differ much among themselves, but as the voltage increased the differences were more marked. There was only one quotation on 75,000-volt cables; all but one of the manufacturers requested to do so bid on 50,000-volt cable; all requests for prices at the lower voltages were complied with, and it is fair to assume that all reliable, experienced cable manufacturers stand ready to furnish and guarantee three-conductor cables, as large as No. 4-0, for tensions as high as 35,000 volts.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

The Furnace-Fan Season.

It is about this time of year that central-station companies and electrical contractors in Northern latitudes should be looking after an increase of their revenue by furnace-fan business. About two years ago we first called attention to this electrical convenience in houses heated with hot-air furnaces, and the demand for this kind of apparatus has brought on the market regular furnace-fan blowing outfits to replace the common fan motor for furnace blowing which at first was used. The effect of having a furnace-fan blower in every house heated with a hot-air furnace in a central-station company's territory is not to be ignored. There is no electrical convenience that is likely to create more enthusiasm for electric service than this, as it shortens the time of heating a house in the morning, and makes it possible to make rooms comfortable which have been heretofore difficult to heat because of the poor natural circulation of air. In some cases it will save the owner the expense of taking out a hot-air furnace and replacing it with a steam or hot-water heating system for heating distant rooms. The live central-station company will be prepared to supply (or have the local contractor supply) furnace-fan blowing outfits on short notice when the cold weather first strikes. The makeshift sometimes employed of simply setting the fan motor in the cold-air intake is not to be recommended. The arrangement must be such that the opening or casing through which the fan blows is no greater in diameter than the fan; otherwise it is difficult to create a good pressure. This being the case, it is also necessary to remove from the cold-air intake the obstruction caused by the fan motor and casing when the fan is not in use. For example, the opening through which the fan blows will usually be a round hole from 12 in. to 16 in. in diameter, whereas the unrestricted cold-air opening may be 1.5 ft. x 2 ft. To remove the fan motor with its box or casing, it is only necessary to arrange it to slide up and down, suspended by a wire cable with a counterweight at the other end; or if there is sufficient room, it can be made to slide sideways out of the cold-air intake. When the counterweight scheme is used, the motor can be raised and lowered and the switch turned on and off from the floor above.

New Use for Electric Heating Pad.

Users of gasoline automobiles as a precaution against explosion generally employ electric lamps to light their garages. A physician who purchases electric energy from the Poughkeepsie Light, Heat & Power Company has found another use for electricity in his garage. As is well known, a gasoline vehicle if left standing for a number of hours in winter months

is not easily started, because the engine becomes cold. The radiators, unless filled with some special solution, are also apt to freeze, so that the engines are often left running when standing on the street.

A practising physician is subject to call at all hours of the day or night, and in order that he may be able to use his automobile at a moment's notice, the physician referred to places an electric heating pad under the hood of the vehicle, closes the hood and then throws a blanket over the front of the hood and radiator. The pad is left in circuit all night, taking about as much energy as an incandescent lamp, and the engine and radiator are kept moderately warm. By this means the vehicle is ready for any emergency call and can be started without excessive cranking.

Cost System for Central Stations.

An interesting portion of a paper presented by Mr. G. H. Gamper before the Ohio Society of Mechanical, Electrical and Steam Engineers at a meeting at Toledo, Nov. 20 and 21, relates to the system of accounts kept at the Columbus municipal plant. Mr. Gamper is the superintendent of the municipal lighting plant at Columbus, Ohio, and the first part of his paper is devoted to a description of the installation. The equipment comprises three 600-hp Westinghouse turbines and one 1500-hp Allis-Chalmers turbine, direct-connected to two-phase, 60-cycle, 2200-volt generators rated at 400 kw and 1000 kw respectively. Steam is generated in three batteries of B. & W. water-tube boilers fitted with superheaters, Dutch-oven furnaces and stokers. The greater part of the present plant was erected in 1903, so that the installation comes up to the requirements of modern practice.

The system of cost-keeping devised the first of March was not running smoothly until the first of July, since which time an accurate record is kept of everything used in connection with the plant. Before a job is started, either new work or a repair job, a cost-and-time estimate is made out by the foreman or whoever is in charge of the work to be done and an estimate of cost of the material and labor. A foreman's job order is issued to the foreman, which is filled out in exact duplicate of the job order on file, on which the foreman enters the time, check number and material used. This is used as a check on the store room requisitions and time. The cost-and-time estimate is submitted for approval, which gives the superintendent a chance to determine for himself whether this work is necessary, or whether it can be done in a different way with less cost. When it is approved, it goes to the clerk, who fills out a job order blank and gives the job a number. This blank is kept on file in the office, together with the cost-and-time estimate. Every day the time of the men working on this job order on file in the office is entered on the back, giving the man's number, his rate, the date, and total time. On the front is entered the requisition number, the date, the amount of material and value of the material, or the name of the firm and amount of its invoice. On the completion of the job the foreman sends in his job order marked complete, and the job is then closed, the labor is calculated and entered on the front, and is added in with the material. If any material is taken out for use on the job and not needed it is returned to the stock room and the storekeeper sends in a credit slip. This is deducted from the cost and an actual cost of the job is obtained.

A list of what is called general job orders is issued each month. On these job orders are entered the small items, such as packings, gage glasses, oil, waste, etc., and anything that costs under a dollar. These are closed each month. After the job orders are closed for the month and the cost calculated, the latter is then distributed to the different accounts, which are enumerated in the upper right-hand corner of the blank. The sum of the different accounts is then entered on the monthly reports.

In making out requisition for supplies, two blanks of different colors are used; one, which is numbered, is used for supplies drawn from the store room, if the material is in stock. If it is not in the store room, the storekeeper sends in a white requisition to the office for the material, either for stock or for the job. If the amount is small, it is purchased direct, but if it is a large amount, a quotation sheet is sent to the different supply houses, which is returned, properly filled out with prices. The lowest and best quotation is accepted. A requisition in triplicate is then issued, numbered in the upper left-hand corner. Below the requisition numbers appears the job order number, and in the upper right-hand corner the fund from which the bill is paid. The requisition contains the firm's name, the material and prices. These requisition blanks are of different colors; the white copy goes to the dealer, the pink copy to the auditor with the voucher and bill for payment, and the yellow copy remains on file at the office. This yellow copy has the receipt of the storekeeper or whoever received the goods, the date the bill was approved, and the person's name who checked it. If at any time in looking over a completed job order information is wanted as to what was furnished, it is only necessary to go to the requisition file and look up the number of the requisition as given on the job order and ascertain exactly what that requisition called for.

If a job requires the use of a horse, the horse's time is charged to that job. The total cost of the stable for the month is determined and divided by the number of horses, which gives the cost of each horse per month. This cost is then divided by the number of days in the month and then by the number of hours in a day, which gives the hourly rate to be charged for the horse's time.

In regard to the monthly reports, everything is taken into account: the service, transmission, generation, expense, etc. On this report is given the complete gross cost of the lamp per month, also the cost per lamp up to date, and these are compared with the previous year. In determining the cost of the fuel per month, the cost of handling the coal and ashes is taken into consideration; all the coal being weighed as used, a very accurate cost of the fuel consumed is obtained. The administration expense includes all the office force, from the superintendent down to the janitor and storekeeper. A sinking fund is provided to take care of maintenance costs and depreciation, which is based on the value of the plant.

A boiler room and turbine room log sheet are kept. On the boiler room log sheet hourly readings are taken of the superheat temperature, the flue gas temperature, as it leaves each boiler and before and after leaving the economizer, feed-water temperature before entering the boiler and before entering the economizer and the draft in the combustion chamber of each boiler. The object of reading the temperature is to keep a check on the foreman and on the condition of the boilers and furnaces. Provision is also made to connect up at a moment's notice an Orsat gas apparatus to analyze the flue gases. By these checks a fireman is always compelled to do his best and give explanations if he does not. A record is kept of the amount of coal consumed and the amount of water evaporated, which is determined by hot-water meters; the evaporation per pound of coal is thus found and a record is kept of it. On the turbine room log sheet is kept a record of the total output of each phase, pressure, vacuum, primary volts and amperes of each turbo-generator set in operation, also volts and amperes of exciters, power factor, and, finally, the kilowatts and amperes of each circuit. By a special arrangement of connections the kilowatts of each circuit can be read direct from a common meter.

The "outages" are reported by the police and citizens directly to the plant. The switchboard operator who takes these reports fills out a trouble blank, giving the location of the lamp, the time reported and the party reporting the same and the date. These are given to the trimmer whose district is nearest the lamp reported out. If he can repair the lamp, he does so and fills out the lower part of the blank, stating the trouble, the number of the lamp, the time repairs were made, and the job order number, and signs the blank, returning it to the office.

where it is filed. If he cannot locate the trouble, the lamp is taken down and replaced by another one. The blank on which he records the time when the lamp was taken down and the number of the lamp which replaced it is put inside of the lamp and the lamp repairer makes the report as to the cause of the trouble. In this way outages can be reduced to a minimum.

In working out the lines and trimmers' routes, a city map is pasted on a board. Brass nails are driven in the board wherever a lamp is located. By means of different colored threads the trunk lines and loops are swung in. A thread is also used to show the exact route and lamps each trimmer is to trim in his district. These districts and routes are determined by the chief electrician and are typewritten—a copy being given to each trimmer and one kept on file in the office. By this means the shortest possible route can be taken and the management does not have to depend on the trimmers, as a new man can be put to trimming without loss of time. Before this method was used it took four trimmers to trim the lamps and one man to take care of the outages. Three men are now trimming the lamps and taking care of all outages without trouble, and instead of trimming an average of 80 lamps per day, they are now trimming on an average 140 lamps per day in addition to taking care of the outages.

Some trouble has been experienced with the wire-using corporations of Columbus making use of the city poles at will, also taking out city poles and substituting their own. To prevent this in future a complete record of the poles has been obtained. A separate card is made out and kept on file, giving the number, location, height, wire, etc., of each pole, and on the back of the card a record of foreign contact. A complete description of each pole can now be obtained from the files and any changes noted.

All the switchboard instruments are calibrated every month, precision meters being purchased for that purpose. From every car of coal a sample is taken and analyzed, and should the coal fail to come up to standard it is rejected.

Analysis of the Operation of a Small Central Station.

By Louis P. Zimmerman.

The economical operation of large plants backed by sufficient capital and a private company is a simple matter to making a plant in a small town end the year with the balance on the right side of the ledger. At Tracy, Minn., is a one-man lighting plant that is a good example of what can be accomplished with fair equipment and careful expenditures. The writer had the opportunity to make some tests on this plant recently to determine the cost of operation and why the plant did not give the entire satisfaction expected of it.

The city of Tracy is located in Lyon County, Minnesota, and is of some importance as a railroad town, being a division point on the Chicago & Northwestern Railroad, as well as an agricultural center. Its population is 2100, and will probably not increase materially for some time. For some years up to June, 1907, the city had a 110-volt direct-current system for lighting and a Brush arc machine for street lighting. In June, 1907, the present alternating-current system was installed and has given good results for a year. It is a 60-cycle, single-phase system with 110-volt secondaries and 1100-volt primaries. There are 28 arcs in series, supplied with 2650 volts by a step-up transformer located in the plant. The city water system is run in connection with the plant. The plant is located about two blocks from the center of electrical load. The main building, 50 ft. x 50 ft., is of red brick, one story high, and is fairly well lighted and equipped for one-man operation.

The water, supplied by a deep well, is lifted by a deep-well pump of the plunger-and-valve type, geared to a gas engine, and stored as pumped in a 34-ft. storage cistern. During the period of light load, between 12 and 4 a. m., the water is forced into an elevated supply tank by a compound duplex steam pump. The city mains are connected to this elevated tank.

The plant has one 150-hp main and one 60-hp auxiliary horizontal, multitubular, fire-tube boiler, equipped with a Cochrane feed-water heater, a Blake feed pump supplying feed water at about 190 deg. Fahr. Coal is hauled from the railroad freight yards about a quarter of a mile in wagons and stored in a 16-ft. x 80-ft. coal shed. The coal required daily is hauled by a wheelbarrow, weighed-in on a platform scales and dumped in front of the boilers, coal enough being hauled in during the day to last over night.

Steam and water gages, feed-water heater and feed pump are in the engine room, where the attendant can see them while near the generators, the boiler room being separated from the engine room by a fireproof brick wall with a connecting door at the rear of the boiler room.

There are two generating units. One consists of a 60-hp American Ball, automatic governor, high-pressure, simple engine direct-connected to a 37.5-kw alternating-current, three-phase Electric Machinery Company (Minneapolis) generator run as a single-phase machine; the other is a 120-hp American Ball compound engine direct-connected to a 75-kw, three-phase, 60-cycle alternating-current Electric Machinery Company generator run as a single-phase machine. Both engines run semi-condensing into an open feed-water heater.

The switchboard, of two commercial feeder panels, two generator panels and an arc panel and Stanley arc-light regulator, is equipped complete with Westinghouse ammeters, voltmeters, integrating wattmeters, high-tension oil switches, ground detectors and the necessary starting switches. There are two sets of busbars of No. 4-0 asbestos-covered wire with double-pole oil switches, so that either generator can be connected with either feeder panel. The switchboard, the two generators, the steam pump, the throttles and the gages are compactly arranged so that one attendant can take care of them without an undue amount of walking around. Records of the switchboard readings are taken half hourly, including time of operation of plant and arc lamps, hours of water pumped, amount of oil and coal used, kind of weather; any stops are noted and the reports are handed to the city recorder every week.

The town has three principal feeder circuits, a commercial circuit, a residence circuit and a series arc-light circuit, the transmission system running principally through the streets, alleys being used only to reach isolated customers. There are in all 24 transformers, with a rated capacity of 46.8 kw, of the Thomson-Houston and Lakon makes, located wherever needed.

Light is sold to 174 customers, as follows: Stores and offices, 65; residences, 95; churches and halls, 14. All charges for light are by meter, there being but one rate, 14 cents per kw-hour, with a reduction of 10 per cent on the bill if paid before the twenty-fifth of the month. Meters are owned by the customers.

Very little is known in detail of the cost of operation of a plant of this size, as no extensive records are kept and no distinction is made between operating expense and interest on investment, while depreciation is generally not considered at all. The writer made a few tests to determine the cost of light delivered at the customers' meters, the efficiency of the plant and its financial success. The conclusions arrived at are, I believe, typical of many plants of this size.

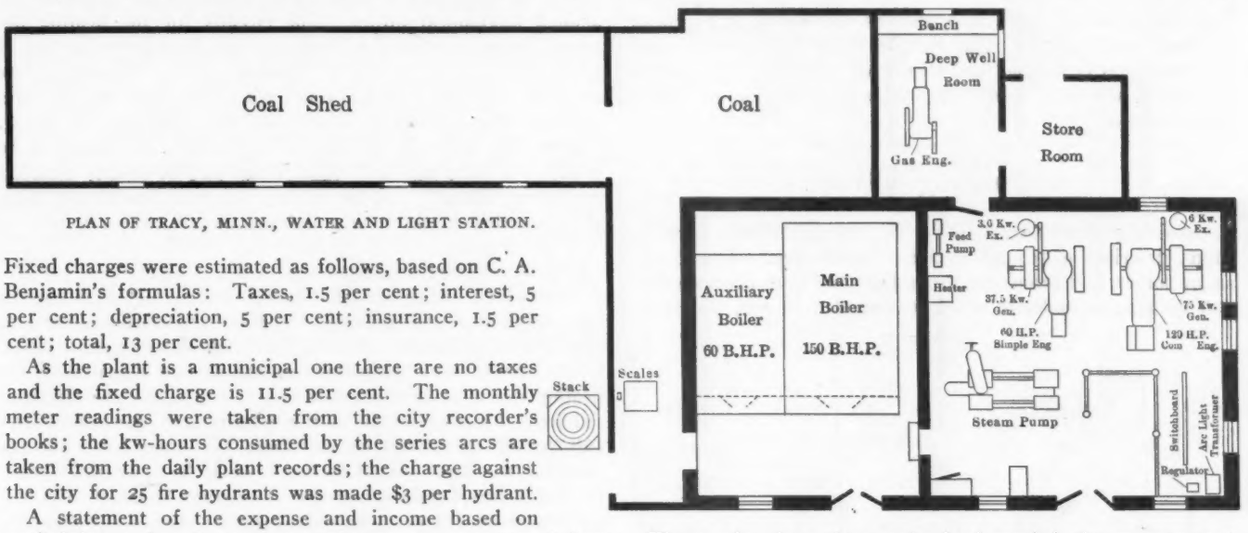
Lighting System:		
Buildings and lot	$2,050	
Boilers, complete	2,825	
Generators, complete	9,205	
		$14,080
Wire on poles	$3,473	
Transformers	1,740	
Miscellaneous	890	
		6,103
		$20,183
Water System:		
Wells, towers, tanks and mains, complete		$25,800
Total investment		$45,983

The plant is taken care of by the day engineer, who is repair man and meter reader, at $60 per month; a night engineer at

$60 per month and a fireman at $40 per month, making a total of $160 per month for labor.

The investment involved in the plant was obtained from the purchase prices and records, the rest being evaluated as accurately as possible. The figures are given on page 1298.

For values on the income and the expense of the plant, the following was prepared for the month of December, 1907. The total expense in any plant includes fixed charges, labor and amount expended for coal and maintenance. The coal consumed was obtained from the daily records kept at the plant.



PLAN OF TRACY, MINN., WATER AND LIGHT STATION.

Fixed charges were estimated as follows, based on C. A. Benjamin's formulas: Taxes, 1.5 per cent; interest, 5 per cent; depreciation, 5 per cent; insurance, 1.5 per cent; total, 13 per cent.

As the plant is a municipal one there are no taxes and the fixed charge is 11.5 per cent. The monthly meter readings were taken from the city recorder's books; the kw-hours consumed by the series arcs are taken from the daily plant records; the charge against the city for 25 fire hydrants was made $3 per hydrant.

A statement of the expense and income based on capital invested and actual operating expense appears below:

Lighting System:

Expense.		
Interest on $20,183	$195	
Labor	120	
Coal	285	
		$600
Income.		
5400 kw-hours at 14 cents, less 10 per cent	$680	
Street lights	150	
		830
Net income		$230

Water System:

Expense.		
Interest on $25,800	$247	
Labor	40	
Coal	15	
		$302
Income.		
Water rents	$155	
Fire hydrants	75	
		230
Deficiency in water system		$72
Total net income of plant		$158

In this report the city was charged for street lights at 10 cents per kw-hour and fire hydrants at $3 a month. In the accounts of the city this is not done, but is supplied from the general city fund. As the excess is $158 and the city street light and water tax is $225, the difference, $77, is supplied from the city fund. This should be charged against the city, as it would be if a private corporation were furnishing the power.

Two tests were made to determine the general condition of plant operation, the first being a normal load and the second a constant-load test of the generators. The amount of coal consumed was weighed and the ash weighed back; the output was measured by calibrated meters at the switchboard. The cost at the customers' meters was found by getting the line loss, which was done with sufficient accuracy by taking readings of customers' meters and station meters simultaneously, and again after a month's interval. The average per cent line loss for the month was used.

The tabulated results for the normal load run are given below:

Average total cost per kw-hour at the switchboard	$0.062
Average total cost per kw-hour at the customers' meters	.081
Average per cent line loss	27
Average per cent efficiency of both engines and generators	78
Average per cent efficiency of generator and engine No. 1	75
Average per cent efficiency of generator and engine No. 2	80
Average per cent efficiency from generators to customer	57
Average power factor	.76
Average power-house voltage	1,210

On the full-load test on the small generator No. 1 the constant electrical load was 31.8 kw. The coal consumption was 9.7 lb. per hp-hour.

Cost of coal per kw-hour	$0.0299
Total cost per kw-hour	.0436
Efficiency of engine and generator	82%

For the compound engine No. 2 the constant electrical load was 67.3 kw and the coal per hp-hour was 5.9 lb.

Cost of coal per kw-hour	$0.0185
Total cost per kw-hour	.03255
Average efficiency of generators	90%

The results show that at the load carried, the average cost per kw-hour is 8.1 cents at the customers' meters, and 6.26 cents and 5.15 cents at full-load of the generators, or a full-load average of 5.7 cents per kw-hour. Hence it costs 2.4 cents per kw-hour more to run the plant at the normal load generally carried for the whole night than if the plant was run at the full capacity of the generators.

There are three ways of cutting down costs in this plant. First, the plant could be shut down at midnight, thus avoiding the costly night load after 12 o'clock until morning when the cost of energy often runs up to about 7 cents per kw-hour, but this is doubtful economy, because a lighted town is its best burglar protection. The second and most needed is the rearrangement of the transformers, cutting out the small, inefficient ones with their high constant core loss; and the third, is the use of a better grade of coal, as the coal now used has about 15 per cent of ash and clinkers and burns very poorly.

INTERIOR WIRING AND ILLUMINATION

Cheap House Wiring.

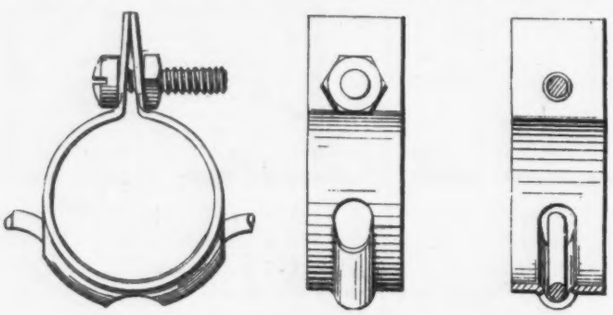
In commenting on a series of articles on cheap house wiring which has recently appeared in the London *Electrical Times*, Mr. P. Fredk. Allan expressed the opinion that in cheap houses concealed wiring should be confined to very exposed positions or where decorations would be spoiled by the appearance of open work. In wiring old houses it is often desirable to keep down the cost and to avoid disturbing the decorations. In a good many cases where the principal gas fittings are of good pattern, it is advised to alter them to suit bayonet lamp holders and wire them with good "flexible" after being well cleaned out. The continuation across the ceiling of the flexible for these fittings, although not so artistic as might be desirable, will often be more artistic than anything else in the room. The smaller fittings, brackets, etc., will be best replaced by plain or slightly ornamental pendants, as desired.

Mr. Allan stated that the only objections to the above scheme

worth considering are that a black mark is formed on the ceiling above the line of flexible, and that the flexible is liable to be damaged in redecorating. Regarding the first objection, he said that it is evident that by using a slightly greater clearance between the ceiling or wall and the flexible, the effect will be much reduced. In any case, it is a trouble which manifests itself only on a direct-current system, and is more noticeable with a cheap cotton-covered than with a good silk-covered flexible. In discussing the second objection, Mr. Allan said it is evident that, by the adoption of electric light, the redecoration periods are from three to five times as far apart as they would be with gas; also, that as the wiring is so cheap to erect, it will also be cheap to take down and re-erect when the decoration is finished and that, even then, the total cost of decoration will be a small item compared with that of a gas-lighted house.

Grounding Clamp.

A patent granted Dec. 1 to W. H. Vibber, of New London, Conn., describes a grounding clamp which dispenses with the use of solder, and brings the grounding wire into direct contact with the pipe or cables to which it is applied, thereby providing



GROUNDING CLAMP.

for the direct passage of current from the latter to the grounding wire. Other advantages claimed are compactness, durability, simplicity and cheapness. The accompanying illustration shows clearly the features of the clamp.

Electric Heating and Cooking Circuits.

Much has been done in the way of making electric heating and cooking more popular, but a great deal yet remains to be done. Many electric-light companies make low rates for energy used for this purpose, and the manufacturers have done their part in improving manufacturing methods and the apparatus in detail so that the cost of cooking and heating utensils has been somewhat lessened. The electrical method of heating appeals to many because of its convenience and cleanliness. Efforts have been made to impart a cheerfulness to the heat by combining luminosity with it; but it will be many years before the fire in the sitting room will be abandoned. At seasons of the year when a little warmth is required at intervals, there can be no doubt of the efficacy of the electric heating devices. Electric cooking devices can be used at all times so that the income from the latter source will necessarily be greater than that derived from purely heating devices.

In order, however, for electric-light companies to give a low rate on energy used for heating and cooking purposes, there should be a separate meter and separate circuits provided. If this does not obtain it is necessary to modify existing wiring circuits to a considerable extent, and even then there will be cause for dissatisfaction in arranging the rates. Only very small heating and cooking devices can be attached to lighting circuits without blowing the fuses. Since every lamp circuit carrying 660 watts or less must be separately fused, and since lighting circuits are usually loaded up to the limit of the 660 watts, it is evident that during the day heating devices requiring only 660 watts in the aggregate can be employed, and if used at night, when lamps are burning, the fuse will blow unless a heavier fuse is inserted. The latter procedure is a violation of the rules of the Underwriters, and if detected would result in the cancellation of the insurance policy or a penalty in the shape of a higher rate of insurance.

Electrical connection to heaters, cooking utensils, etc., should be securely made in the same manner that conductors are attached to motors or other devices dealing with currents equal to those employed in heating apparatus. The conductors should be thoroughly insulated and reinforced with a protection against mechanical injury. The circuits for the heating devices can be as conveniently run as circuits for motors, and if heating appliances would be looked upon as coming in the same wiring class as motors and not in the same wiring class as lamps there would be no difficulty in laying out the wiring. The trouble is due to the ease with which these devices can be attached to lamp circuits. Motors can also be readily attached to lighting circuits; but the average wireman would not think of connecting a motor to a lighting circuit, unless it were a very small motor.

For all ordinary household uses a single main circuit of No. 6 wire would suffice for all heating devices. Branch circuits can be run to pocket outlets in the floor or to baseboard receptacles in the rooms where heating and cooking apparatus is used. There should be a main fuse at the service entrance if the heating circuit is on a separate meter, and where the circuit is fed from the same service as the lighting load, the heating circuit would, of course, be run from the panel box; but the mains to the panel should be larger or as large as No. 6 wire. In houses where lighting circuits are already installed, it is better to run the No. 6 circuit from near the service entrance and independent of the lighting mains.

The arrangement of baseboard receptacles and plug switches for such apparatus leaves nothing to be desired. In the kitchen where an electric stove is installed the circuit may be run up to a point opposite the stove connection, or about 3 ft. above the floor. The same arrangement can be used for electric flat-irons in the laundry, or the latter circuit may be brought down from overhead. A 6-lb. iron should have from 500 to 550 watts, and a 16-lb. iron, such as used by a tailor, requires in the neighborhood of 700 watts. A new type of instantaneous electric water heater recently placed on the market requires 1200 watts, so that the need of separate circuits is readily apparent. Aside from the curling-iron heater and the electric heating pad and some of the smaller irons and heating apparatus, no heating device can be connected to a lighting circuit already in use without danger of blowing fuses. Nearly all of the cooking devices require from 440 to 600 watts, and such devices as griddles, ovens, broilers and all stoves over 7 in. in diameter take over 600 watts. With a No. 6 wire used for the heating circuit, apparatus aggregating about 5 kw can be connected at once and there are very few households where such a circuit will be overloaded or even loaded. The difference in the cost of smaller wire and No. 6 for heating circuits is too slight to be taken into consideration, and the saving in energy due to the larger wire will more than offset its additional cost. With baseboard receptacles and plug connections, a very flexible arrangement results, if sufficient receptacles are installed.

The actual wiring of such circuits is very simple. In a modern cottage, for instance, where the dining room, kitchen and laundry would be on one floor, under which is the cellar with floor beams exposed, open knob and tube work or wooden molding could be used in running the mains. Porcelain cut-outs could be installed for making connections to the baseboard receptacles and 40-amp fuses used, the circuit throughout being No. 6. Mixed wiring could be employed by running flexible or rigid conduit fitted with condulets from the receptacle to the cut-out, or if expense is no object a straight exposed conduit or flexible cable job may be installed. It is evident that the number of branch circuits is not large nor their length such as to make them expensive. The connections are simple and easily made, and the installation will answer all requirements.

The largest heating device may be used in any of the rooms by simply placing the plug in the base receptacle, and with all the heating devices in use at once there is no danger of fuses blowing. The same receptacles may be used for portable lamps on ornate standards, for vacuum cleaners, fans or any other of the numerous devices used in the household.

New Telephone Patents.

An indicator especially designed for hotel use, where the signal may be used as a notice to call the office, has been patented by Mr. E. T. Ducharme, of Boston. The indicator is arranged above the instrument and a target within a shield may be thrown in front of a window by means of the bell clapper. The target is linked to the hook-switch in such a manner that each time the telephone is returned to the hook it is withdrawn from the window, while as soon as the clapper begins to move the target is thrown out of balance and falls in front of the window, where it remains by its own weight.

For military use there is at times required a compact transmitter which is proof against damage both from rough handling and moisture. Mr. G. F. Atwood, of East Orange, N. J., has patented a transmitter designed for this use, his patent being assigned to the Western Electric Company. The transmitter is held within a casing of about the size of the ordinary watch-case receiver. The usual mouthpiece has been superseded by a flat metal plate, perforated with numerous small holes, and the diaphragm is protected by means of a waterproof membrane behind this plate. The rear of the instrument forms a terminal casing, as well as a circuit switch casing. The cords enter this rear casing through a comparatively long sleeve, while a push button extends through its opposite wall. The transmitter terminals occupy the center of the terminal casing, while about its edge the spiral springs of the switch device are placed. The casing is closed from the rear by means of a circular cap piece.

APPARATUS FOR PARTY LINES.

With party-line ringing it is always of advantage to have the keys so arranged that the operator may at a glance note which particular key of any group was last depressed, as by this means she may avoid the necessity of asking which station was called in the case of re-rings. Mr. C. F. Winston, of Chicago, has obtained a patent for accomplishing the indication by means of auxiliary plungers. Beside each operating plunger in his ringing key there extends an indicating plunger, capped with some substance of a distinctive color. When any one of the pushes is depressed the auxiliary plunger goes down with it, and when the operating plunger is allowed to return, the auxiliary plunger remains depressed, being released only upon the depression of some other auxiliary plunger of the key in connection with the operation of its corresponding operating plunger. The release and locking of the plungers are accomplished by means of a spring trigger, which is sprung and reset with each depression of an operating plunger. Mr. Winston's patent is assigned to the Kellogg Switchboard & Supply Company.

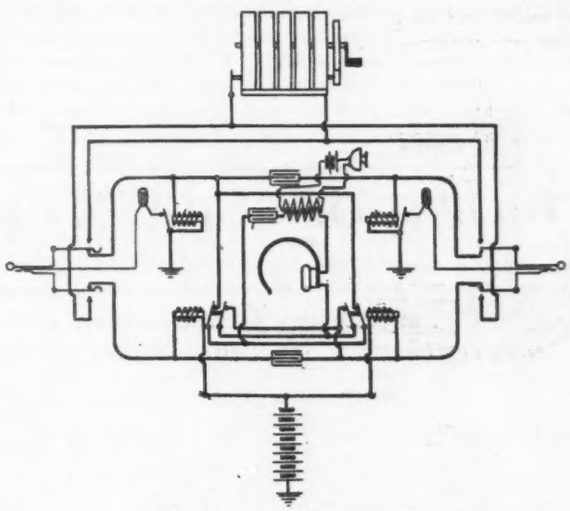
In another form of long key—this the joint invention of E. R. Corwin and C. A. Beals, of Chicago—the individual key plungers, beneath the key plate, are formed with special cam surfaces. A slide bar, sliding at right angles to the plunger motion, is arranged with a pin bearing against the cam surface of each plunger, the pins being held in contact by means of a spring at the end of the slide bar. The cam surfaces are so designed that when any plunger is depressed the slide bar is first pushed to one side in a manner to release any plungers which may have been depressed and then allowed to return to normal, with one of its pins locking in a semi-depressed position the plunger just operated. The patent for this key is assigned to the Corwin Manufacturing Company.

A step-by-step party-line system, especially designed for rural lines, has been patented by P. V. Smith, of Lyons, Kan. The control at the various stations lies in a mechanism operated by means of a pawl in the usual manner. A circular contact dial is used to control the electrical impulses, which operate the various stepping mechanisms. The release is accomplished through an auxiliary circuit, which is closed by pressing the dial arm down hard upon any one of the contacts. These contacts are spring affairs in the nature of push buttons, and, when pressed hard, close a releasing circuit. The system as at present designed requires five wires between all stations.

Improvements to his auxiliary party-line step-by-step system form the subject of a patent granted to Mr. G. Babcock, of Rochester, N. Y., and assigned by him to the Stromberg-Carlson Company. Mr. Babcock states that with the present improvements he has provided a system in which the apparatus at the substations on two lines may be practically operated at the same time from the central exchange, in which all but the desired stations are locked out from conversation; that a double supervision is provided, the supervision for each line being independent; the supervisory apparatus being also provided to indicate, release and restore, so that at the completion of every connection the operator is completely advised as to the condition of the selective mechanism at all stations.

NEW SWITCHBOARD CIRCUITS.

Herewith is shown a switchboard cord circuit with an automatic listening device, relays being included to control the connection of the operator's listening taps to the cord circuit. It will be noted that a listening control relay is associated with each cord of the cord pair and that the operator's circuit is connected through the contacts of both of these in such a manner as to be disconnected only when both relays are operated, the condition existing during conversation over the cord pair. The patent for this circuit is assigned to the Corwin Telephone Manufacturing Company by the inventor, E. R. Corwin.



CORWIN SWITCHBOARD CIRCUIT.

M. S. Conner has obtained three recent patents for switchboard circuits, all assigned to the Stromberg-Carlson Company. Of these, one relates to a supervisory system, the signals being controlled by a compound relay rather than two ordinary relays. In the compound relay, the armature of one part, in the non-operated position, maintains the contacts open, by its pressure upon the second armature. When the first part is energized, the armature is pulled down, allowing the second armature to fall and the contacts to close. The energization of the second coil opens the contacts by its action upon its own armature. A second of Mr. Conner's patents relates to a special toll cord circuit, wherein the cord is switched by relays from one signal scheme to another, according to what kind of line the cord is used with, the control relays responding to differences in the line-jack circuits. The third patent describes a special form of trunk circuit wherein the supply of ringing current to the trunk cord is contingent upon the distant *A* operator having picked up the trunk at its outgoing end.

AUTOMATIC RINGING.

With automatic and continuous ringing as at present carried out, it is customary to lead the ringing current to the switchboard through a commutator. This commutator, as usually ar-

ranged, cuts off all current for a certain period and then applies it for a certain period. It will at once be seen that as ringing only takes place during the ringing period on the commutator, there is, or may be, an accumulation of calls waiting to be rung, with the result that a great demand is made upon the ringing machine during the ringing period and no demand upon the silent period. To overcome this Mr. M. S. Conner, of Rochester, N. Y., has patented a system wherein there is used a considerable number of commutators, each spaced at a definite angle with regard to the others and each feeding its own section of the switchboard. With such an arrangement the silent periods on some sections become ringing periods on others, with a result that a practically continuous output is demanded from the ringing machine.

Another patent granted to the same inventor relates to a locking key for use in connection with continuous ringing. The key is provided with the usual plungers and springs, but the plungers become locked in the depressed position by means of a locking bar, controlled by an electromagnet, mounted in conjunction with the key. The ringing current is carried through the magnet coil, but is of insufficient magnitude to operate the armature as long as the receivers along the line rung are all upon the hooks. When, however, a low resistance path for the ringing current is afforded by the operation of any hook-switch, sufficient current passes through the electromagnet to trip the key and cut off the ringing current. Both of these patents have been assigned to the Stromberg-Carlson Company.

Letter to the Editors.

Time-Element Circuit-Breaker.

To the Editors of Electrical World:

Sirs:—Your issue of Nov. 21 contains on page 1127 an article on the desirability of a circuit-breaker with time constant in connection with electric motors, and gives also some suggestions how to arrange such a circuit-breaker.

It appears that a simpler and more reliable way to accomplish this purpose is to use a thermostat in series with the circuit-breaker, and an auxiliary tripping coil arranged to become energized when the thermostat reaches a certain temperature. A suitable thermostat for this purpose may be made of two strips of brass and iron brazed or riveted together, connected as a part of the main circuit, and arranged so that, when heated sufficiently by the current, it will bend and close a contact for energizing the tripping coil. Such a compound metallic strip will have the desirable characteristics of a fuse without its objectionable features. The auxiliary tripping coil can be so connected as to eliminate all sparking between the strip and the contact; the length of the time limit can be varied by adjusting the distance between the contact and the strip. Such a device has been on the market for some time in Germany.

New York. Gustaf Rennerfelt.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Testing of Alternators.—S. P. Smith.—A paper read before the Birmingham section of the British Institution of Electrical Engineers on methods of testing alternators in which the actual full-load conditions are exactly imitated by supplying the total losses. For this purpose the machine is electrically divided into two parts, one acting as a generating unit and the other as a motor unit. The method of Behrend, which consists merely in splitting up the field winding into two halves, has the disadvantage that the machine becomes magnetically unbalanced. In a modification of Behrend's method developed by the present author a few years ago, the field winding is still split up into two halves, but the motor or weakly-excited poles are symmetrically interspersed among the generator or strongly excited poles, so

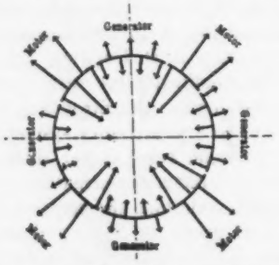


FIG. 1.—TESTING OF ALTERNATORS.

that the whole revolving system is balanced with respect to the shaft. This method has electrical disadvantages. For a perfect method it is highly important that there be no dangerous resultant magnetic pull with respect to the rotor shaft; this is the chief mechanical consideration. Electrically the requirements are full-load exciting current with full-load armature current and full-load core losses. The author has developed such a method as follows: in his new method all of the field coils are in series and carry the full-load exciting current, hence full heating of the field structure is obtained, and the exciter works under normal full-load conditions. The example of a 48-pole machine is shown in Fig. 1. Of these 48 poles, four groups were reversed, these groups consisting of two sets of four poles diametrically opposite, and two sets of five poles at right angles to these. Hence in all there were 18 poles reversed and 30 poles connected as for normal working. The latter were the generator poles and the former the motor poles. Thus there were 30 generator poles versus 18 motor poles. Under these conditions, full-load current flowed through the short-circuited armature when full-load exciting current was sent through the field coils. Hence, provided the heating of the armature is correct, there is little doubt about the heating of the stator copper, consequently the criterion of the test is the stator iron loss or core heating. Some curves shown by the author gave the results of two tests taken on the above machine on a load of 470 kw at unity power-factor, and two by using the author's method—that is, 18 motor poles versus 30 generator poles. These curves showed that the temperature rise obtained by the author's test was the same as on actual load. In addition to this, the iron loss was measured on open circuit, both when the machine was excited with the poles normally connected and when 18 were reversed, by reading the input to the driving motor. This was found to be approximately the same in each case. In the above test the rotor field winding was opened at eight places, but it could equally well have been opened at four places, provided the proper ratio of motor to generator poles were maintained. An experiment was made to see if it were possible to reverse all the 18 poles in one group, so that the field winding need be opened in only two places. On open circuit the machines ran quite smoothly with full-load exciting current in the field coils, but as soon as the armature was short-circuited the machine shook badly and the test had to be discontinued. The reason for the out-of-balance is armature reaction. From this it is seen that it is essential to have the rotor balanced, even in slow-speed machines, and for this purpose the minimum number of openings in the rotor field winding is four—namely, two diametrically opposite groups reversed. To find the efficiency of an alternator connected in the above manner one has merely to measure the input to the driving motor when the alternator is running on short circuit, with full-load current circulating in the armature and normal

exciting current in the field coils; then deducting from this the input to the driving motor when running light and uncoupled, the total losses in the alternator and exciter are at once obtained.—Lond. *Electrician,* Nov. 13; Lond. *Elec. Eng'ing,* Nov. 19.

Transformer Magnetizing Currents.—While values up to 15 per cent exciting current for induction motors have always been standard practice and have caused no unfavorable comment, that of transformers has generally been in the vicinity of 4 per cent. With the new alloy steels, which have a much smaller loss per pound of material, it may be advisable in many cases to increase the magnetic density, and the question of proper

	Per cent reactance voltage.			
Per cent mag. current.	1	2	3	4
	Per cent regulation drop.			
0	1	1	1	1
2.5	1.025	1.05	1.075	1.10
5	1.05	1.1	1.15	1.20
10	1.10	1.2	1.30	1.40
15	1.15	1.3	1.45	1.60
20	1.20	1.4	1.60	1.80
25	1.25	1.5	1.75	2.00

limitations of exciting current demands consideration. The anonymous author has worked out several tables to show the actual effect of an increase of magnetizing current in the transformer on transmission and distribution systems. From these tables it follows that magnetizing currents up to 10 per cent or 15 per cent, with as low as 1/10 load, do not give very bad results, and that higher values could readily be allowed under certain conditions. Among the problems worked out is the effect of magnetizing current on the regulation of a transformer having 1 per cent IR drop and different percentage reactance when carrying non-inductive load. The results for this case are given above.—*Gen. Elec. Rev.,* December.

Parallel Connection of Transformers.—K. FAYE-HANSEN.—An illustrated article discussing the correct method of operating three-phase transformers in parallel. To avoid mistakes in making connections it is recommended to stamp the signs Δ or ∇ and γ or λ on the name-plate of the machine.—*Elek. Zeit.,* Nov. 5.

Regulation of Repulsion Motors by Displacement of Brushes.—W. UHDE.—The author refers to his patent of 1900, on the basis of which he claims priority for some speed regulation methods, attributed by others to Deri, Latour and Schueler.—*Elek. Zeit.,* Nov. 17.

Lamps and Lighting.

Berlin.—L. BLOCH.—An account of recent progress in the illumination of the streets of Berlin. The chief developments of recent years are the use of high-pressure inverted gas mantles and of new flame arc lamps. The introduction of inverted gas lamps has increased the available mean illumination, but also increased the ratio of maximum to minimum. During the last years the ordinary carbon lamps have been replaced by flame arcs with inclined electrodes. More recently a new variety of "Alba" electrodes has been brought out, which combine the merits both of flame electrodes and electrodes of the ordinary variety. These electrodes yield a pure white light, and can be utilized vertically. Owing to the great diameter of the electrodes, they have about the same number of burning hours as ordinary carbon electrodes. On the other hand, the specific power consumption is very low, being given as 0.14 watt to 0.15 watt per mean hemispherical hefner candle, exclusive of the loss by absorption of globes and in the series resistors. Finally, the curve of distribution of light from such electrodes is preferable for street lighting to that of the older flame arcs, which throw all the light immediately downward. The final conclusion is that gas lighting has made great progress by the introduction of the inverted high-pressure lamps, but that electric lighting has likewise been enabled to hold its position by the use of intense flame arcs and, more recently, by the introduction and use of flame arcs with the "Alba" electrodes. In cases in which high-pressure gas had begun to displace the old ordinary arc lamps, the introduction of the newer lamps referred to above has enabled electric lighting to more than hold its own. But it is impossible to contend that either of the illuminants is invariably the cheaper; each case must be considered on its merits, and the decision depends on the local conditions.—*Illum. Eng.* (Lond.), November.

Osram Lamps.—A note on a recent price reduction of osram lamps in England. The low voltage patterns, 100 volts to 130 volts, 28-watt, 35-watt and 55-watt, will in future be 3s. 6d. each (85 cents), instead of 4s. (97 cents), and the 25-volt, 2s. 6d. (61 cents). The most marked reduction is, however, to be made in the "high-voltage" (presumably meaning 220 volts) 50-65-watt lamps, the use of which is to be encouraged in every possible way. The original price of 6s. ($1.46) is to be altered to 4s. 9d. ($1.16). A further change is that of the 50-55-volt lamp, which will be marketed at 3s. (73 cents), and it is hoped that this lamp will be used on small transformer circuits in greater numbers than the 25-volt, seeing that the higher voltage will not so seriously introduce the problem of higher current and greater voltage drop as on 25-volt circuits. With this pattern of lamp the consumer has also a greater choice of candle-power, the range being extended from the 16 cp of the 25-volt lamp to 25 cp and 32 cp. The life of the various osram lamps is stated to be from 1500 hours to 6000 hours, with a loss in candle-power not exceeding 10 per cent.—Lond. *Electrician,* Nov. 20.—The prices of the tantalum lamps have also been reduced in England from 3s. 6d. (85 cents) to 3s. (73 cents) for 65-75-volt and 100-160-volt, 32-cp, spherical bulb, and 100-160-volt, 50-cp, "sun tantalum lamps," both for bell and spherical globes.—Lond. *Elec. Eng'ing,* Nov. 19.

Metallic-Filament Lamps.—Notes on some recent British patents for the manufacture of metallic filaments. A patent of H. Aron and A. Geiger (15,079) relates to a process of decarbonizing metal filaments by heating them to a high temperature in a vacuum chamber. No free hydrogen need be introduced, but it is necessary that a small percentage of water vapor should be present. The correct vapor density is obtained by inserting a vessel containing slightly diluted sulphuric acid or potash lye in the vacuum chamber. A patent of W. D. Coolidge (16,534) relates to the production of a tungsten filament without using carbon at all. Powdered tungsten metal is mixed with a binder consisting of 42 parts of cadmium, 53 parts of mercury, and 5 parts of lead. This binder gives the necessary ductility and strength, does not combine chemically with the tungsten, and does not lead to trouble due to contained carbon. The mixture may consist of from 30 per cent to 50 per cent by weight of tungsten. A small percentage of bismuth can be substituted for some of the lead in the alloy binder with advantage.—Lond. *Elec. Eng'ing,* Nov. 19.

Metallic-Filament Lamps.—B. DUSCHNITZ.—A continuation of his long serial. In his present instalment the author describes, on the basis of recent patent specifications, various apparatus for making metallic filaments on a large scale. Among them is an electric tube furnace for baking the filaments; a method of employing the ballast resistor of the Nernst lamp (iron resistors in a hydrogen atmosphere) for preventing the current through the filament from rising beyond the safety limit during the gradual decrease of resistance due to reduction; also apparatus for bending the filaments.—*Elek. Anz.,* Nov. 8 and 19.

Tungsten Lamp.—J. A. YUNCK.—A communication claiming the priority for the invention of the tungsten lamp for an American electrochemist, T. D. Bottome, the year of invention being given as 1887 (patent 401,120 of 1889).—*Electrochem. and Met. Ind.,* December.

Metallic-Filament Lamps.—C. R. BOEHM.—An article in which the author gives a long list of patents which may be considered as representing the pioneer stage preceding the invention of the modern metallic-filament lamp.—*Elek. Anz.,* Nov. 12.

Arc Lamps.—R. MYLO.—An illustrated description of a method used by the Berlin electricity works for controlling and switching in and out the arc lamps of the system from the power station. In each district the arc lamps are connected to one feeding point and these points are connected with a switchboard in the central station whereby it is possible to connect or disconnect at will each group of lamps. The ar-

rangement also permits supervision of the lamps during operation.—*Elek. Zeit.*, Nov. 5.

Effects of Lamps on Eyesight.—Laporte and Broca.—An account of an experimental investigation on the effect of different artificial sources of light on the eyesight. These experiments were carried on with electric-incandescent lamps and a mercury-vapor lamp, and included tests of visual acuity, speed of reading, effect on pupil-aperture and the production of retinal images. The authors' experiments suggest the conclusion that the difference in the color of these sources is of little consequence, and that brightness is the important factor.—*Bull. Soc. Int. des Elec.*, June; *Illum. Eng.* (Lond), November.

Miners' Lamps.—Schreiber.—A fully illustrated paper read before the Electrical Society of Frankfort. The author describes various types of safety lamps for mines.—*Elek. Zeit.*, Nov. 5.

Generation, Transmission and Distribution.

Exhaust-Steam Power Plant.—An illustrated description of an exhaust-steam generating station at a British blast furnace iron plant. There are two exhaust-steam turbines, each rated at 1350 kw. The turbines are arranged for working with exhaust steam derived from three blowing engines, a turbo-blower, and a few exhausters. The electrical generators are of the three-phase type, capable of working at a pressure of from 2500 volts to 2875 volts and 40 cycles per second, and are capable of giving their full output on a power factor of between 0.7 and 0.8. The e.m.f. is raised to 11,000 volts for transmission. —Lond. *Elec. Rev.*, Nov. 20.

Safety Devices for Hauling Gear.—The automatic overload circuit-breaker may sometimes be the cause of accidents to the machinery itself in the case of electrically-operated haulage gear. When the motor becomes overloaded and the maximum

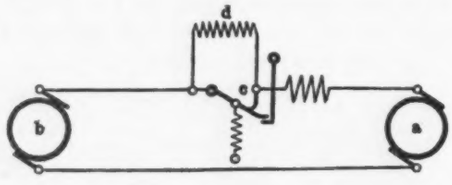


FIG. 2.—DIAGRAM OF PROTECTIVE DEVICE.

circuit-breaker has come into action, the load begins to pull back the gear and the motor, and serious accidents are often the result unless the driver has the presence of mind to apply the brake at once, as operating with the control lever is useless when the electrical circuit is once broken. Fig. 2 shows a safety device used by a German company to prevent accidents in case the circuit should suddenly be interrupted. The circuit-breaker is connected up in such a manner that when its overload coil acts, the main circuit is only partially instead of completely opened. The driver is thus enabled to bring the haulage gear to rest by using only the control lever, from which he may not, on any account, release his hold. In the diagram, which is practically self-explanatory, *a* is the haulage motor, *b* the generator, and *c* the automatic circuit-breaker, to which the resistor *d*, which is preferably in series with the overload coil, is connected. If now an overload occurs to cause the circuit-breaker to fly out, then a small amount of current still flows to the motor through the resistor *d*, sufficient to enable the driver to bring the motor to rest by means of the control lever. This resistor, being connected in parallel with the circuit-breaker, also acts as a buffer, and serves to take up the shock which naturally occurs when the circuit is suddenly interrupted.—Lond. *Electrician*, Nov. 20.

Electric Pumping in Mines.—K. Perlewitz.—An illustrated description of the equipment of a German mine with a centrifugal pump for handling 7 cu. m of water per minute, the height being 580 m. The pump is driven by a 1350-hp, 5000-volt, three-phase induction motor.—*Elek. Zeit.*, Nov. 19.

Mines in Chile.—An illustrated description of a hydro-electric plant in Chile. The power house contains three 455-hp turbines coupled to three-phase generators. The energy is transmitted at 20,000 volts to substations and is used especially in saltpeter mines.—Lond. *Elec. Review*, Nov. 20.

Electric Power in Agriculture.—K. Krohne.—A note supplementing his recent article on this subject. The author gives statistical tables on the power and time required with hand work and mechanical devices for various agricultural purposes. —*Elek. Zeit.*, Nov. 5.

Traction.

Wurtemberg.—Yeesenmeyer.—A paper in which the author discusses the financial results which would follow from an electrification of the Wurtemberg State railways. He finds that the cost of operation per year would be reduced by about $325,000, and this would represent interest at the rate of 3.2 per cent on the necessary investment for the electric equipment of the road.—*Elek. Zeit.*, Nov. 5.

Electric Locomotives.—P. Dawson.—A continuation of his long illustrated serial on electric traction on railways. The author remarks that much can be said in favor of electric locomotives as against motorcars. In this instalment he discusses the reasons which give electric locomotives the advantage. He first considers gearless locomotives, describing the different forms of construction adopted and referring to recent examples, and then passes on to the geared-motor type. The pros and cons of gearless as compared with geared locomotives are discussed, and finally the advantages which, under given conditions of operation, electric locomotives possess over the latest and most economical steam locomotives are discussed.—Lond. *Electrician*, Nov. 20.

Single and Three-Phase Traction.—C. L. de Muralt.—A note in which the author expresses the opinion that the continuous-current system is most suitable for comparatively short distances and heavy traffic, the single-phase system for long distances, but for light traffic only, and the three-phase system for long distances and for heavy traffic.—*Elec. Railway Jour.*, Nov. 28.

Speed-Time Curves.—J. Jaubert.—An article illustrated by diagrams discussing the great advantages of the method of speed-time curves for solving many practical problems.—*La Lumière Elec.*, Nov. 14.

Installations, Systems and Appliances.

Tax on Electricity and Gas in Italy.—F. Fasolt.—Some data on the tax on electrical energy and illuminating gas which has been in use in Italy since 1895. Illuminating gas and electrical energy are taxed simply for lighting and heating. There is no tax on the use of electricity or gas for other industrial purposes nor for public lighting of streets and squares, nor for any other purpose except private lighting and heating. No tax is charged on heating for industrial purposes. The tax amounts to two centesimi (0.4 cent) for each cubic meter of illuminating gas made from coal, eight centesimi (1.6 cents) for each cubic meter of illuminating gas made from mineral oil, and six centesimi (1.2 cents) for each kilowatt-hour of electrical energy. Some data are given on the working of this tax in practice. It is stated that the red tape connected with the necessary control and bookkeeping has led to new and troublesome expenses, and the possibility of paying the tax in the form of a flat sum per year has caused many controversies between the works and the tax office concerning the number of average lighting hours, etc.—*Elek. Zeit.*, Nov. 19.

Aluminum Cables.—H. Teissier du Cros.—A mathematical note on the possibility of using aluminum for underground cables for energy transmission. The author shows that this would offer distinct economies for the transmission of large amounts of energy over long distances by means of the Thury direct-current series system.—*La Lumière Elec.*, Nov. 21.

Overhead Work.—E. Goolding.—Notes on the construction of overhead work for tramways, especially the choice of the best section of the trolley wire. Some figures are also given on the cost of overhead equipment.—Lond. *Elec. Review*, Nov. 20.

Electrophysics and Magnetism.

Hysteresis.—In contradistinction with the magnetic behavior of magnetic metals like iron, etc., paramagnetic and diamagnetic substances are generally assumed to have a susceptibility independent of field strength. Only in the case of iron oxide a

decrease of susceptibility with increasing field strength and traces of hysteresis and remenant magnetism have been observed. The author has tested iron oxide, iron hydroxide, iron chloride and ferrous and ferric sulphate. The first two show distinct hysteresis and remenant magnetism. In the other three substances the author could not detect hysteresis.—*Phys. Zeit.*, Nov. 1.

Law of Induction.—F. EMDE.—The first part of a highly theoretical discussion of some fundamental points in connection with the law of induction. Some critical remarks are made on Hering's recent experiment. The paper is to be continued.—*Elek. und Masch.* (Vienna), Nov. 15.

Electrochemistry and Batteries.

Alkaline Battery.—R. GOLDSCHMIDT.—Some notes on results obtained with a zinc-nickel oxide accumulator with potassium carbonate as electrolyte. The best results are obtained with the active mass deposited electrolytically on an iron-wire screen. The e.m.f. is slightly below two volts.—*Centralbl. f. Accum.*, Nov. 5.

Electric Welding.—O. SEFFERS.—The first part of an illustrated description of electric welding apparatus made by German companies. The author discusses both welding with the arc and resistance welding.—*Elek. Anz.*, Nov. 12.

American Electrochemical Society.—A full account of the recent New York convention with abstracts of all of the papers presented.—*Electrochem. and Met. Ind.*, December.

Units, Measurements and Instruments.

Portable Photometer.—An illustrated description of the Siemens-Halske portable photometer which enables tests to be made without any dark room. The method of measuring is based on the "angle-mirror" method adopted by the German Association of Electrical Engineers. The apparatus, shown in

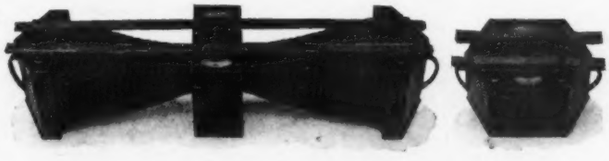


FIG. 3.—PORTABLE PHOTOMETER.

Fig. 3, comprises three boxes connected by folding accordions, which are folded up when out of use, in order to form a handy transportable parcel. The central part of the apparatus contains a voltmeter, an ammeter, the photometer screen, and, screwed on top of it, two folding guide-rails, which at the same time receive the millimeter and candle-power scales. The ammeter and voltmeter are connected to the circuit in such a way as to indicate only the current traversing the lamp, and the potential difference between the terminals of the lamp, thus measuring in watts the consumption of the incandescent lamp alone. The circuit is practically non-inductive. The Bunsen method is used for photometrical tests, but the grease spot is replaced by a silvered spot between two plates of ground glass. Both the measuring instruments and the scales can be read from the top of the screen, and the screen is likewise inspected from above, which greatly facilitates the operation. Each of the two lateral parts of the apparatus contains two mirrors, inclined at an angle of 120 deg. to one another, and the standard lamp and the lamp under test respectively. Both lamps are suspended, and the apparatus can be used in connection with osmium and other suspended lamps. Measurements can be carried out at any place in full daylight, the apparatus being connected by means of a plug and flexible cord to any ordinary lamp socket. As the standard lamp and the lamp under test are connected up in parallel, the former having in circuit an additional resistance corresponding to the resistance of the ampmeter inserted into the circuit of the latter, both lamps are subjected to identical voltages, and can be directly compared.—Lond. *Elec. Rev.*, Nov. 20.

Standard Cells.—G. HULETT.—An account of an experimental investigation of the chemical equilibria in the Clark cell and in the Weston cell. The research refers especially to the cathode systems.—*Phys. Rev.*, November.

Energy Measurements in Single-Phase Three-Wire Systems.—R. KOPP.—The author shows that the usual induction motors with two main-current coils and a single voltage coil can be used for measuring energy in single-phase three-wire systems, under all conditions of load, if the shunts of these meters are connected between the two outers.—*Elek. Zeit.*, Nov. 12.

Telegraphy, Telephony and Signals.

Wireless Telegraphy and Telephony.—W. H. ECCLES.—The conclusion of his illustrated article giving a summary of various recent British patents on wireless telegraphy and telephony.—Lond. *Elec.*, Nov. 12.

Telephony.—TURPAIN.—The first part of an article, illustrated by numerous diagrams, sketching the development of telephony from the early times of Bell to modern multiple automatic systems.—*La Revue Elec.*, Nov. 15.

Telephony.—H. VON HELLRIGL.—An article giving four statistical tables on telephony (lines, equipment and financial results) in the different countries of the world, except the United States.—*Elek. und Masch.* (Vienna), Nov. 15.

Alternating Current for Telephony.—A. MAIOR.—A note on the use of alternating current for multiplex telephony. The adjustment to the resonance condition and the increase of frequency have a favorable effect on the transmission of speech.—*Elek. Zeit.*, Nov. 19.

Telephony.—S. P. GRACE.—An illustrated paper read before the Engineers' Society of Western Pennsylvania and giving a historical sketch of the development of telephony since 1875. Also an account of the discussion which followed. In the discussion E. B. Tuttle remarked that when Pupin worked out a satisfactory practical method of loading lines with inductance coils, it was found that reflection losses between loaded and non-loaded lines were very considerable, and a very expensive and complicated terminal tapering or gradual reduction of the loading at the ends was made use of to reduce the reflection loss. This was found very satisfactory from the operating standpoint, but was found to be too expensive for general use. Within the last year a specially-designed transformer has been found to do this work and the work of repeating coil also, thus accomplishing the saving from reflection losses with but very slight additional cost. The design of switchboards, although nearly as perfect as is conceivable from the present operative standpoint, "will shortly give way to an entirely different type of board which will be more economical and more rapid." L. C. Moore asked the opinion of the author as to glass poles, if they could be made cheap enough commercially, as a substitute for the wooden pole. They are made hollow, 10.5 in. at the butt, 7.5 in. at the top, 28 ft. high, and there are some 200 of them in use now on the Imperial Post lines in Germany where they are being experimented with. "They put the glass poles at the angles, where the wire took a sharp turn, and where the line ran straight there would be eight or ten wooden poles, and farther on would be glass poles again." S. P. Grace replied that if it can be shown that a glass pole is amply strong and in the end cheaper, it would be used. For the present it has been concluded in this country to let the matter of glass poles rest for a while. Creosoted wooden poles are the next step.—*Proceedings* of the Engineers' Society of Western Pennsylvania, October.

BOOK REVIEWS.

AGENDE DE L'ELECTRO. 1908 Première Année. Bruxelles: Revue International D'Electricite. 280 pages, 35 illustrations. Price, 5 francs.

This little pocket-book has been prepared especially for the use of the Belgian engineers, and without doubt answers its purpose and should be serviceable to American readers, as it contains in very handy form much data and information of general interest. An account of the different systems of steam turbines is followed by interesting data as to the cost of various

kinds of power stations. Elevators, railways, telegraphy, electroplating, accidents and numerous other subjects are entered into with more or less detail. In this day of rapid progress in illuminating engineering it is astonishing to read the item of which the following is a translation: "Reflectors, Globes: The reflectors increase the glare, but do not give a good effect. Not much in use. Opal globes absorb 20 per cent to 26 per cent of light; frosted globes absorb 40 per cent to 50 per cent."

Die Elektrischen Kohlengluhfadenlampen Ihre Herstellung und Prufung. By Heinrich Weber. Hannover: Dr. Max Janecke, Verlagsbuchhandlung. 260 pages, 116 illustrations. Price, 9 marks.

The above book on "The Electric Carbon Incandescent-Filament Lamp, Its Manufacture and Testing," supplements a book by the same author on "The Carbon Incandescent-Filament." The author states in the preface that in both books a number of facts are revealed which up to the present time have been carefully guarded by the lamp manufacturers. It is, however, unfortunate that the secrets are made public at a time when the old carbon-filament is being made obsolete by the more efficient metallic-filaments.

The book itself, as well as its predecessor, is rather complete, and the numerous data appear to have been compiled with scrupulous thoroughness and exactness. A short historical introduction is followed by an exhaustive description of the methods of sealing the leading-in wires. All the other steps in lamp manufacture are treated by special chapters, of which chapter 8 is of special interest, as it discusses the cause of the blackening of the globes and the methods of preventing and diminishing the same. As to the methods of frosting the lamp, it must be noted that frosting by means of organic solutions and enameling has been entirely omitted.

Altogether, the book contains much valuable information and will incidentally be of assistance with respect to the manufacture of metallic-filament lamps. The author has been connected for years with a lamp factory and his opinions are therefore based on practical experience.

How To Build Up Furnace Efficiency. By Jos. .W Hays. Published by the author, 601 Hartford Building, Chicago. Fifty cents.

This is a little booklet devoted mainly to the use of the CO_2 hand-testing instrument for flue gas testing. It is not in any way a manual of instructions for the manipulation of the instrument, but a step by step analysis of boiler furnace conditions, in which the various essential questions which must come up in locating furnace waste are stated, and the method of determining the answer to them by means of flue gas analysis is given. It is plain that the author is not an advocate of the use of an expensive flue gas recording or indicating outfit until conditions have first been analyzed and the best methods of operation determined by comparatively inexpensive and easily manipulated hand-testing devices. It is a booklet that will indicate to the man in charge of a boiler plant where to look for the causes of fuel waste and how to go about stopping them.

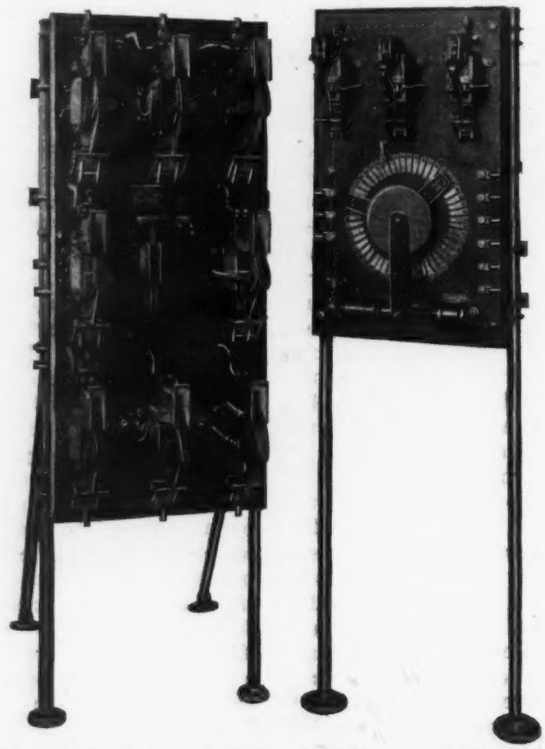
NEW APPARATUS AND APPLIANCES

Automatic Starters for Induction Motors.

There has existed for some time a demand for reliable devices to automatically start and control from a distance induction motors operating pumps, air compressors, blowers, etc. The General Electric Company has now on the market a complete line of automatic starters for polyphase induction motors of both the slip-ring and squirrel-cage types in ratings of 5 hp and above and for potentials ranging from 110 volts to 2080 volts.

In Fig. 1 is shown an automatic starter for squirrel-cage induction motors for 550 volts or less. The apparatus consists of a panel on which are mounted eight alternating-current contactors and a time-limit relay, the starting "compensator" coils and overload fuses being mounted on the rear of the panel.

A cycle of operation is as follows: The solenoid and relay circuit is closed either by means of a governor—the operation of which depends on air or water pressure—or by means of an auxiliary push-button switch, or the line circuit can be closed and opened with a double-pole or triple-pole oil switch. In either case, the closing of the solenoid and relay circuits closes five of the eight contactors, the time-limit being governed by an air dash-pot on the relay. This action connects the compensator coils to the line and at the same time connects the motor to the coils, doing automatically that which is accomplished by a hand-operated compensator when the switch is thrown into the starting position. When the plunger of the time-limit relay has reached the end of its travel, it quickly opens the solenoid windings of the five contactors and at the same time closes the remaining three. This latter operation connects the motor directly to the line. When it is desired to stop the motor the pressure governor, float switch, etc., as the case may be, opens the circuit through the solenoid coils of the three contactors, thereby allowing the motor to come to rest. This cycle of operation is repeated automatically and as often as is required to keep the water level at a predetermined point or the air at a certain pressure, etc.



FIGS. 1 AND 2.—AUTOMATIC STARTERS FOR SQUIRREL-CAGE AND SLIP-RING TYPES OF INDUCTION MOTORS.

In Fig. 2 is shown an automatic starter for slip-ring type of induction motors. The apparatus consists of a panel at the top

of which is mounted a primary switch consisting of three alternating-current contactors, and below these a three-phase secondary switch operating over three sets of resistance contacts, the resistance being mounted and connected on the back of the panel.

The first step in the cycle of operation is similar to that with the first mentioned type of starter, the circuit through the coil of the solenoid operating the ratchet being closed by means of a float switch, pressure governor, etc. As soon as this circuit has been closed the three-phase switch is moved forward, the movement of the solenoid plunger being transmitted to the arms by means of a toggle joint which moves a pawl engaging a notched disk fastened to the arm. The rate of movement of the arm is determined by an air dash-pot placed opposite the solenoid. When the first contact point is reached a circuit is established through the coils of the three contactors, thereby closing them and connecting the motor directly to the line with all of the resistance in the secondary circuit. The three-phase switch still continuing to move over the contacts, as the motor accelerates, gradually cuts the resistance out until the secondary is short-circuited, at which instant the circuit through the solenoid operating the ratchet is broken and the movable switch stops its rotary motion.

The motor continues to run until the tank is full or the air or water pressure is at a certain value, or, in the case of remote hand control, when the auxiliary switch or oil switch is opened, at which time the circuit through the contactor coils is broken. The contactors then open, allowing the motor to come to rest.

When the motor starts again this cycle is repeated, the three-phase arm being advanced forward from the position in which it last stopped. In other words, when the motor has started and stopped three times, a point on one arm of the switch will have traveled the entire distance around the circle formed by the contact points.

Single-Phase Motors for Car Propulsion.

In the single-phase motors which the Westinghouse Electric & Manufacturing Company is building for the motor-cars of the New York, New Haven & Hartford Railroad Company use will be made of a spring suspension, the essential element

FIG. 1.—QUILL MOUNTING.

of which is a quill similar to those on which the armatures of the gearless motors for locomotives are mounted. The quill

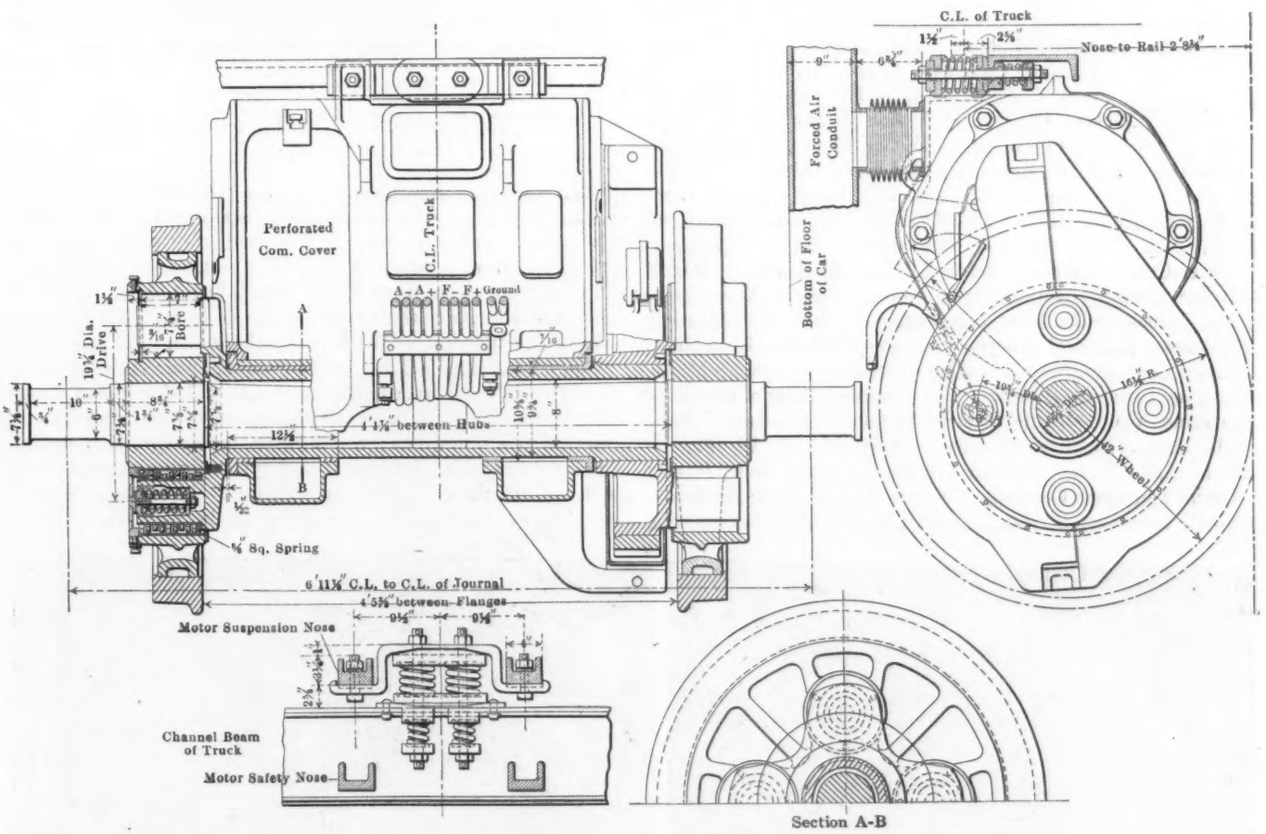


FIG. 2.—SECTIONAL VIEWS OF SINGLE-PHASE MOTOR.

arrangement was described and illustrated in the issues of the ELECTRICAL WORLD for March 31 and April 14, 1906. In the present instance, however, the quill encloses the axle instead of forming the armature shaft, and is carried from each wheel by means of four pins located in spring pockets in the wheel and surrounded by eccentrically-wound helical springs. The motor and gear are mounted upon this quill. By this arrangement, a view of which is shown in Fig. 1, the gear centers are

rigidly maintained, while at the same time a spring support is secured for that part of the motor weight that is usually carried directly on the axle. The remainder of the motor weight, which is ordinarily carried by means of the motor nose and supported solidly from the transom of the truck, is carried on a spring cradle, so that the entire motor is flexibly supported.

As shown in Fig. 2, the motor has six poles and six brush arms. Each brush arm is equipped with four brushes measuring ⅜ in. x 2¼ in. The motor has a normal rating of 150 hp on the one-hour basis. It is arranged for forced ventilation. The field-circuit winding is of the compensated-series type, while the armature is provided with preventive-resistance leads, the design being similar to that of the motors that have proved so successful on the locomotives mentioned above. Use is made of partially closed slots and an especially rigid commutator.

The weight of the motor complete with gears, gear case, axle bearings and quill is about 7450 lb., the motor alone weighing approximately 5600 lb. and the quill complete 1400 lb.

Exhibits at the Chicago Telephone Convention.

Among the exhibitors at the International Independent Telephone Association's convention, held at the Auditorium Hotel, Chicago, Dec. 1, 2 and 3, were the following:

American Electric Telephone Company; American Steel & Wire Company, Chicago, Ill.; Automatic Electric Company, Chicago, Ill.; Century Telephone Construction Company, Buffalo, N. Y.; Chicago Telephone Supply Company, Elkhart, Ind.; Cracraft-Leich Electric Company, Genoa, Ill.; H. E. Cobb, Chicago, Ill.; Frank B. Cook, Chicago, Ill.; Corwin Telephone Company, Chicago, Ill.; W. H. Couch, Boston, Mass.; Dean Electric Company, Elyria, Ohio; Duplex Metal Company, New York City; Electric Appliance Company, Chicago, Ill.; Excelsior Supply Company, Chicago, Ill.; Fiber Conduit Company, Orangeburg, N. Y.; Fox & Borden Manufacturing Company, New York City; H. S. Green Battery Company, Holtzer-Cabot Electric Company, Brookline, Mass.; Illinois Electric Company, Chicago, Ill.; Indiana Steel & Wire Company, Muncie, Ind.; Iowa Independent Telephone Association, Manhattan Electrical Supply Company, Chicago, Ill.; Miller Anchor Company, Norwalk, Ohio; Monarch Telephone Manufacturing Company, Chicago, Ill.; National Carbon Company, Cleveland, Ohio; North Electric Company, Cleveland, Ohio; Ohio Brass Company, Mansfield, Ohio; Mr. F. W. Pardee, Chicago, Ill.; Pierce Specialty Company, Elkhart, Ind.; Homer Roberts Telephone Company, Chicago, Ill.; St. Louis Malleable Casting Company, St. Louis, Mo.; Sterling Electric Company, Lafayette, Ind.; Stromberg-Carlson Mfg. Co., Rochester, N. Y.; Swedish-American Company, Chicago, Ill.; The American Telephone Journal, Chicago, Ill.; Vote-Berger Company, La Crosse, Wis.; Warner Electric Company, Muncie, Ind.; Westinghouse Machine Company, East Pittsburg, Pa.

Canopy Switch with Cord.

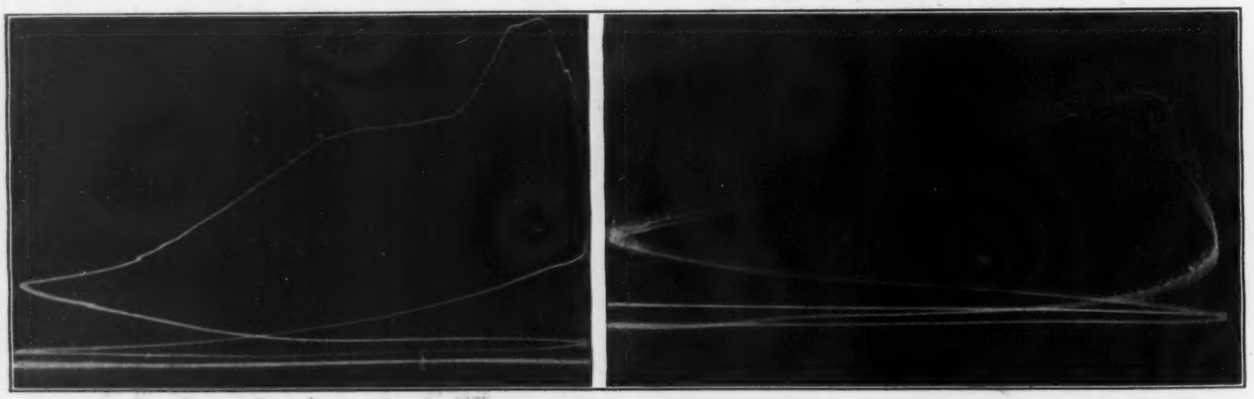
The Benjamin Electric Manufacturing Company, of Chicago, is now making a substantial canopy switch for use with its clusters or on any other fixture. This is illustrated in Figs. 1, 2 and 3. It can be operated either by a piece of clock cord or by an ornamental chain. This cord or chain is less obtrusive than the cord of a pendant switch; hence, this kind of switch may be used in many places where pendant switches have been used heretofore. It also does away with the fire hazard and depreciation of the pendant cord. The switch is made so that lamps on a cluster or chandelier can be operated in two groups. Two or three degrees of illumination may thus be secured. The pulley inside the canopy takes the mechanical strain when the cord is pulled down. If desired, an auxiliary pulley placed on the ceiling, at a distance from the canopy, can be used.

FIGS. 1, 2 AND 3.—CANOPY SWITCH WITH CORD.

Manograph Gas-Engine Cards.

The accompanying illustrations are reproductions of gas-engine cycle cards recorded photographically by the Hospitalier-Carpentier manograph recently described in these columns.

Fig. 1 is from a water-cooled 4-in. x 4-in. engine using gasoline and running at 1500 r.p.m. The effect of dissociation is well marked, while the expansion curve is fair, but the less said of the functioning of the valves the better. Fig. 2 is from an air-cooled 2-in. x 2-in. gasoline engine, four cycle, running at the remarkable speed of 3000 r.p.m. and developing 3 hp. The interesting feature of this diagram is the accession of mixture at a point about one-third up the compression stroke, which was provided for by a special system being experimented with at the time. In this latter case it is remarkable that the time of exposure of the portion of the plate immediately under the spot of light was only 1-46/1000 of a second; the exposure in the diagram of Fig. 1 was 1-23/1000 of a second, resulting in a remarkably clear diagram. We are indebted for the photographs and above information to Hugo C. Gibson, American agent for the manograph.



FIGS. 1 AND 2.—GAS-ENGINE CYCLE CARDS.

Auto-Transformer Motor Starters.

The auto-transformer starter for a squirrel-cage polyphase induction motor, illustrated herewith, possesses the following operating characteristics: The fuses are short-circuited at starting and in the first running positions. The motor is completely disconnected from the circuit when the starter is in the "off" position. The starter may be adjusted for giving any desired voltage to the motor according to the starting condition.

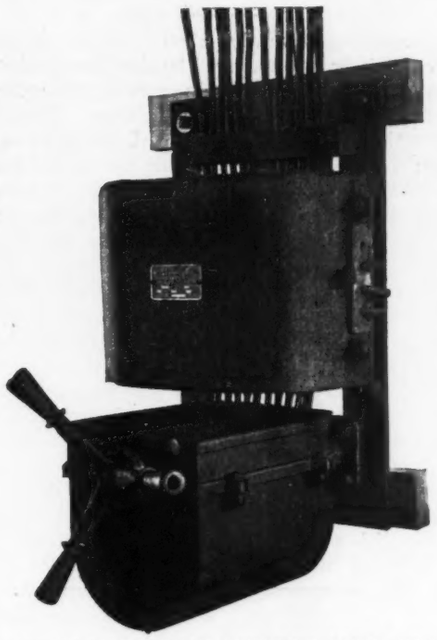


FIG. 1.—COMPLETE AUTO-TRANSFORMER MOTOR STARTER.

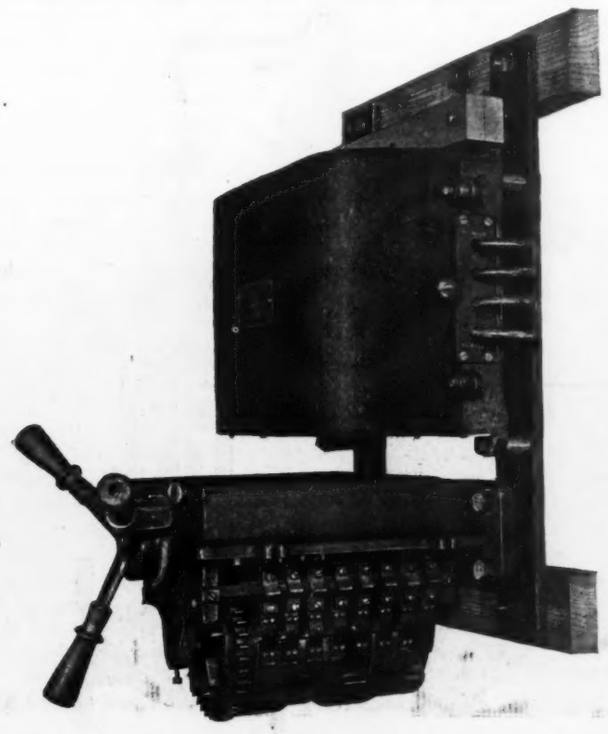


FIG. 2.—AUTO-TRANSFORMER STARTER PARTIALLY WIRED, WITH OIL TANK REMOVED.

All connections are made and broken quickly, by means of a cam mechanism. The actual contact points are renewable. All make-and-break contacts are of the sliding type immersed in oil. The starter for a two-phase motor is identical with that for a three-phase motor. The above-described starter has been developed by the Wagner Electric Manufacturing Company, St. Louis, Mo.

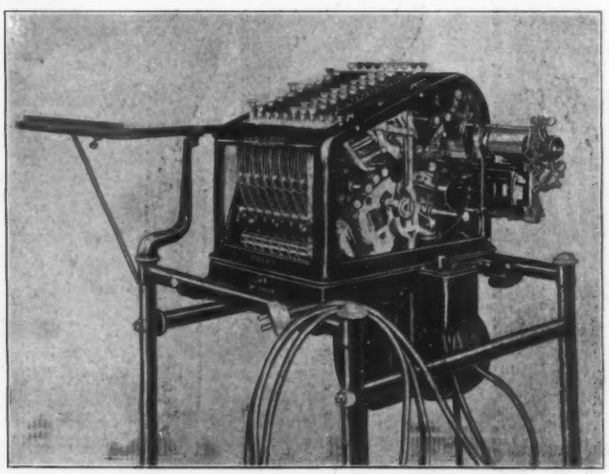
Compact Switchboard Instruments.

The accompanying illustration shows a type of horizontal edgewise instrument designed with particular reference to switchboards on which the area is limited. It is stated that this type of instrument requires the minimum surface area on the switchboard, while affording adequate length and clearness on the indicating scale. The instruments are secured to the board by the current-carrying lugs so that only two holes need be drilled for a voltmeter or an ammeter and four holes for a wattmeter. The line comprises the three forms of instruments just mentioned for both direct-current and alternating-current circuits and for both single-phase and polyphase systems. They are manufactured by the Keystone Electrical Instrument Company, Ninth Street and Montgomery Avenue, Philadelphia.

COMPACT SWITCHBOARD INSTRUMENT.

Motor-Driven Adding Machine.

The ordinary form of adding machine will do adding, subtracting, multiplying and dividing from four to six times as fast as an expert. It is not possible to make errors in the actual performance of the computations, and during operation it does not require the close attention which the human computer must necessarily give his work. By its use in connection with the card systems and other short-cuts devised for especial use with the machine, the efficiency can be much increased. The only mechanical work necessary is the pressing of the keys and the operation of the handle projecting to the right of the case, and the latter has been eliminated in the improved forms by the application of the electric motor.



MOTOR-DRIVEN ADDING MACHINE.

The illustration shows the Burroughs adding machine equipped with a Westinghouse motor. With this improvement

the number is written without any mechanical labor by simply pressing a key on the keyboard of the machine, which throws in a clutch and connects the shaft of the motor with that of the handle. When it is considered that the manipulation of the handle is the only thing in the operation which is tiresome and that this causes a material interruption of the work, it will be seen that the application of the electric motor is a very material advantage. In fact, experiment has shown that the operation is 40 per cent faster, with less liability to error caused by setting the incorrect number, and less labor on the part of the operator when the machine is thus driven.

The Westinghouse motors used with the adding machine have capacities of 1/10 hp or ⅛ hp, the former being used with a machine of seven figures and the latter with one of nine figures. They run at a speed of about 1200 r.p.m., and are furnished for both direct and alternating current. The cost of the operating energy is insignificant, varying from 1 cent to 2 cents an hour, according to the local rates for electric energy. No special wiring is necessary, the motor being connected to an ordinary lighting circuit as readily as an incandescent-light bulb. The motor will run continuously without attention, an occasional oiling once in several months being only necessary.

A Splicing Clamp.

The Cook splicing clamp, shown in Figs. 1, 2 and 3, is an improved tool for making a wire splice, either with a metal sleeve joint, or with bare wire. This tool assembled is shown in Fig. 1. Referring to Fig. 2, which shows the clamp taken apart, it is seen that there is a wheel which can be revolved on its axis to accommodate the different sizes of sleeves or wire which are to be spliced. It is claimed that there is not the tendency to spring apart which is experienced with the old plan.

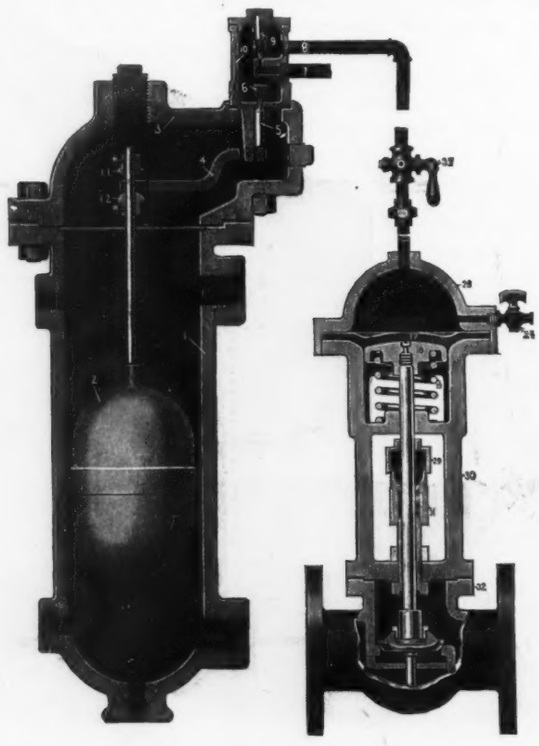
Fig. 3 shows a pair of these clamps finishing a twist sleeve joint. In making an ordinary Western Union splice between bare wires, the wires are first clamped between the jaws and one-half of the splice is twisted. The splice is completed by clamping the finished side and then twisting the remaining half.

FIGS. 1, 2 AND 3.—SPLICING CLAMP.

These clamps are made in 10-in. and 13-in. sizes, giving a range from No. 4 to No. 18 on sleeve joints and from No. 0 to No. 14 for bare wire. This clamp accommodates six different sizes in copper sleeves, and six different sizes of copper or iron wire. In making a common Western Union joint, it is claimed, this clamp will not scrape off the galvanizing on an iron wire. It is manufactured by Frank B. Cook, 246 West Lake Street, Chicago.

Feed-Water Regulator.

The accompanying ilustration shows the mechanism of the feed-water regulator manufactured by the Liberty Manufacturing Company, of Pittsburgh, Pa. In operation the water column is attached to the boiler in the usual manner. Assuming that the water in the boiler is at normal level, the valve on the end of the stem 5 is open and the valve on the end of the stem 9 is closed. Steam is then admitted into the pilot valve chamber, and passing through the pipe 8 enters the chamber on top of the controlling valve, the pressure forcing the controlling valve to its seat. As the water level in the boiler lowers, the weight of the float is gradually transferred to the lever and when the weight of the float overcomes the steam pressure, holding valve 9 on its seat, the latter valve is unseated and the admission valve is closed. The steam contained in the pipe 8 then passes through the exhaust valve and pipe 7 to the atmosphere. The pressure on top of the diaphragm is thus relieved and the controlling valve opens and admits water to the boiler. When the water level has been raised about ½ in., the float also has a tendency to rise, but is prevented from so doing because the steam pressure on the admission valve tends to keep that valve closed. When the weight, due to the increased displacement of the float, overcomes the pressure on the admission valve, and when in consequence the latter opens, the exhaust valve 9 closes, the steam then entering the controlling valve pipe 8 and forcing the controlling valve to its seat. The admission exhaust valves are mounted in one piece and adjustment is accomplished by the removal of the cap on top of the pilot valve chamber 10 and screwing the exhaust valve stem 9 up or down as the case may require. The pilot valve is adjustable under full steam pressure and one valve controls the admission and exhaust ports. Two types of regulator are manufactured.

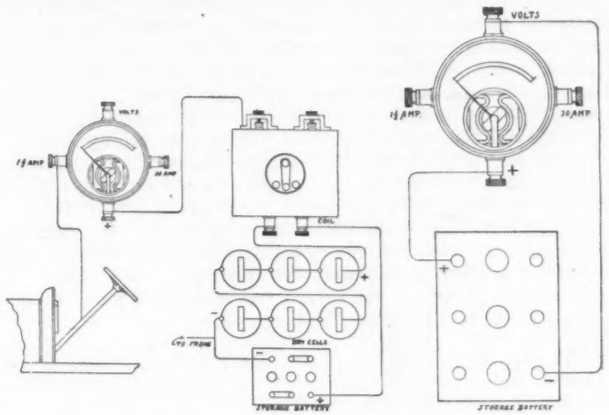


FEED-WATER REGULATOR.

Voltmeter for Use with Gas Engines.

Users of the so-called "explosive" or internal-combustion engines have awakened to a realization of the fact that no matter how good may be the engine it is worthless without a good ignition system, and they have also realized that no matter how good may be an ignition system it is difficult to keep it working properly unless means are at hand by which to adjust it properly.

The instrument illustrated herewith consists of a D'Arsonval-type meter, which has its windings so calculated that it will



FIGS. 1 AND 2.—VOLTMETER FOR USE WITH GAS ENGINES.

give very satisfactory results either as a voltmeter or as an ammeter. By connecting the bottom post to the positive and the top post to the negative, a coil of very high resistance is introduced into the circuit so that the instrument indicates the voltage of that circuit, as shown in Fig. 1, in which the voltage of a storage battery is being measured. By connecting the bottom post to the positive and the right-hand post to the negative, the coil of the instrument is in shunt with a very low resistance, and currents up to 30 amp can be measured. Connecting the positive to the bottom post and the negative to the left-hand post connects the instrument coil in shunt with a somewhat higher resistance so that a maximum of 1½ amp can be measured with this arrangement. Fig. 2 shows the positive of the instrument connected to the contact screw of a coil, while the negative is grounded on the steering column for the purpose of adjusting the vibrators. In this diagram it is assumed that the positive side of the batteries is connected to the coil.

The above-described voltmeter has been placed on the market by the Hoyt Electrical Instrument Works, Penacook, N. H.

The Future for Wooden Poles and Ties.

Mr. J. B. Eccleston, manager of the Georgia Tie, Pole & Timber Company, in an interview with a representative of this journal, said that the enormous and steadily increasing demand for wooden poles and ties has exhausted the Northeastern forests of cedar and chestnut, and also the scant supply of Southern cedar or juniper. The chestnut that is left east of the Mississippi River is jealously guarded for local consumption by the large railroads along which it stands, who have locked it up by excessive freight rates.

"The future supply of ties and poles," he says, "must come from the Southern forest, and over 75 per cent of it now comes from there. The far-seeing have for over 15 years been experimenting in the use of other woods less durable than cedar and much cheaper, and which can be produced in practically unlimited quantities for many years. Of these Southern woods Southern yellow hard pine, because of its hardness, pitch and rosin, is the choice of all steam railroads and of many standard electric railways for ties and octagonal poles, especially of the heart quality, which brings the highest price, as being the most durable under all conditions. The railroads are learning the folly of specifying sawed ties, as thereby they raise the market price to that of sawed lumber, whereas if hewn on four sides by negroes the cost is about 10 cents less per tie.

"The 'Sound Square Edge' or sap ties and poles rot at the ground surface if they are alternately exposed to wet and dry; but if they are set deep and well covered so they constantly remain moist their life is over doubled. A striking illustration of this was at Syracuse, N. Y., where such ties last 12 years and some still were good for use; another test was at Buffalo, N. Y., where ties after 10 years' service were moved and found perfectly sound and were actually again put back in the main track. In this same section of road, and at the same time, white and mixed oak ties were placed, and practically all of the latter were found to have rotted and had mostly to be removed with picks and shovels.

"Sawed octagonal poles are very popular as a substitute for iron poles in city work and cost about one-fifth as much. It is found that their lives are greatly increased by protecting them at the ground level by a slight concrete casing at small cost.

"Many enginers and inspectors make the great mistake of rejecting poles that have scarred butts though such poles are the very best, as the scars are where the tree had been tapped for turpentine, the effect being to turn the butt into a conglomerate of rosin and fiber. Such butts will not rot for 100 years or more; true, they are unshapely, and often appear unsound, but these defects are covered up.

"The cypress round pole is the future round pole. To make up for lack of strength, it is specified about 1 in. larger at the top than chestnut or cedar, the butts averaging smaller and the taper being more gradual. Cypress is very porous and when used in a cold climate great care should be taken to house and seal the tops thoroughly; the poles will absorb moisture like a sponge, and after freezing, become very brittle. As for durability, it almost rivals cedar. There is a very large supply of cypress in the South, and is now becoming almost universally used. Cypress has given good satisfaction when treated as above recommended."

Threading Pipe.

The Oster Manufacturing Company, of Cleveland, Ohio, has added one more to the long line of Oster "Matchless" tools for threading pipe, such for example as is used in electrical work. This is a die stock for threading pipe from 1 in. to 2 in. The dies automatically recede to make standard taper thread; they are controlled by a cam, which, following the lead screw, is driven by a guide post at exact taper for the pipe thread. Standard size is obtained by setting the guide post in position to indicate the size as graduated on the face plate; and locking

DIE STOCK.

solid by the nut at the bottom of the post. This setting remains unaltered as long as duplicate threads are desired. Over- or under-size threads, or crooked threads, can be obtained. One set of dies may be used for all sizes or a set for each size, as the operator prefers.

An exclusive feature is the universal gripping chuck which adjusts to all sizes by revolving a handle. This takes the place of all bushings and makes the stock entirely complete within itself. There are no loose parts. The gripping jaws are of tool steel hardened and will withstand the strain and wear.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE

The return of colder weather has stimulated trade in many lines, but there is still great conservatism on the part of retail purchasers. The holiday trade throughout the country is much better than it was a year ago, but is hardly up to the average of the years previous to 1907. This is due in a large measure to the fact that the year of depression has educated the people to stick to individual economy. There are still many workmen unemployed, and there is less money to be spent. Another thing in connection with the Christmas trade is that assortments offered to the public are less varied and extensive than they have been in former years, as retail merchants have been conservative in their purchases and have replenished their depleted stocks but sparingly. Throughout the North and West conditions seem to be better than in other sections of the country. In the South, buying is temporarily curtailed, because the producers of cotton are dissatisfied with the prevailing prices, and are holding the staple. In the manufacturing sections the purchasing power is lessened by the inactivity of many industries. It is reported in wholesale and jobbing circles that many of the early spring wants have been already filled, but that, as a rule, the orders have been light. The same conservatism that prevailed in the buying for fall delivery is yet in evidence on future orders. In the industrial world we still hear of extensive improvement, but it is more largely in the shape of promises of good things that are to come than of actual orders. There are undoubtedly many inquiries in all branches of the iron and steel industry, and, of course, there is an improvement in the actual ordering of material. It is said that the railroads and the rail manufacturers have practically reached an agreement, and that large orders will soon be announced. The Pennsylvania is reported to be contemplating the purchase of 160,000 tons, which will be divided between the United States Steel Corporation and the independent manufacturers. Other roads are preparing their specifications, and it is confidently predicted that early in January the rail mills will be working full time. An order for 3000 steel cars has been placed with the Pressed Steel Car Company by the Carolina, Clinchfield & Ohio Railroad. Other orders for steel cars aggregate several thousand. The building industry still shows signs of improvement. Reports from 54 cities for November indicate an increase of 51 per cent over November, a year ago. The lumber mills are still busy and the brick makers report a large increase in orders. The leather and shoe industry continues to be brisk and the rubber manufacturers proclaim that they are operating at 80 per cent of full capacity. Failures for the week ended Dec. 3, as reported by *Bradstreet's*, were 234, against 193 last week, 272 in the same week in 1907, 216 in 1906, 203 in 1905, and 231 in 1904.

THE COPPER MARKET.

There has been no decline in the quoted price of copper during the week which ended Dec. 7. There have been no concessions below the quoted price reported. This indicates that the market is as yet strongly held, and that the interests in control are confident of their ability to maintain their position in spite of adverse statistics. The American producers and the domestic selling agencies still talk hopefully of the situation. They are apparently undisturbed by lack of sales and the increasing burden to be carried. Such optimism is pleasant to look upon, but is difficult to understand. The conditions are seemingly in favor of lower prices when ordinary business rules are applied. The production during recent months has been the heaviest in the history of the country; the domestic consumption at the present time is certainly not more than 75 per cent of normal, the exports for November were the smallest of the year with one exception, and the imports of foreign matte and ore are running larger than usual. In addition to this, the speculators of Europe grow less aggressive as money rates become higher, and are more cautious about risking commitments that may be hard to carry. During the month of November there came into sight in the American market from producers and through imports something like 110,000,000 lb. of copper. Exports were a trifle less than 44,000,000 lb., and domestic takings by consumers were estimated at 42,000,000 lb. From these figures there is apparently an accumulation of more than 20,000,000 lb. for the month, and there have been accumulations, of some size, for almost every month since the year began, when—according to the Government report—there was a surplus on hand of 135,000,000 lb. Certainly such records are not encouraging—yet prices hold firm and there is no evidence of selling pressure. Selling agents insist that there are no stocks of any size being carried at home, and that the surplus abroad is being reduced by liberal takings for consumption. One of the hopeful features that is pointed out is the vast number of projects for electrical development which are under consideration and which are only awaiting favorable conditions for financing. The exports of copper for December, up to and including Dec. 7, were 4,576 tons. Prices on the Metal Exchange were:

Lake	14¾ @ 14½
Electrolytic	14⅝ @ 14¼
Castings	14 @ 14⅛

London prices were as follows

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	63	12	6	62	12	6
Standard copper, futures	63	11	3	63	12	6
Market	Easy.			Steady.		
Sales of spot	500 tons					
Sales of futures	1,300 tons					

Extreme fluctuations for this year:

	Highest.			Lowest.		
Lake copper, spot	14½			12⅜		
Electrolytic copper, spot	14⅜			12¼		
Casting copper, spot	14¼			12⅛		
London, spot	£64	17	6	£56	5	0
London, futures	65	15	0	56	17	0
London, best selected	68	10	0	60	0	0

ALUMINUM PRICES GO DOWNWARD.—During the last three months there has been serious demoralization in the aluminum industry. Prices have rapidly declined, and the metal is now selling both in Europe and in this market at about the lowest figure ever known. Previous to the 1907 panic the American price of aluminum was about 42 cents per pound, and the European price from 33 to 35 cents. During the latter months of last year and the early months of 1908 the demand for the metal fell off very materially. The takings of the automobile manufacturers were enormously reduced and other branches of aluminum industries were almost entirely stagnant. The slump in the price of pig tin was another reason for decline in the price of aluminum. The manufacturers who had been using aluminum as a substitute for tin stopped buying when tin became cheaper. The chief cause for the recent break in prices, however, was the dissolution on Sept. 30 of the European convention of producers. This agreement had been holding up prices. As soon as it expired there was a general rush of independent producers into the market and the price declined. At one time it was 13½ cents for ingots in ton lots. It is but very little higher than this figure to-day, ranging between 14½ and 16 cents. In this country the price of aluminum is between 22 and 24 cents per pound for ingots in ton lots. This vast difference in the price here and the price abroad is, of course, due to the 8-cent per pound duty which is imposed by the government. A metal broker states that it is generally understood that the only producer of aluminum in this country fixes its price at about 7½ cents higher than the price which prevails in Europe, thereby retaining the advantage of the 8-cent tariff. The Aluminum Company of America owns the patents covering the methods of production—principally the Bradley and Hall patents. Owing to the fundamental claims of the first-mentioned, which expires next year, the aluminum industry in this country has been closed to all domestic competition. It is said by those familiar with the industry that under these methods the metal can be produced for 8 cents per pound, or to make a liberal estimate, can be produced and marketed at 12 cents per pound. If this is

true, the price will probably fall to 20 cents or less when competition arises through the expiration of the Bradley patent. Aluminum at 20 cents a pound is equivalent in conductivity to copper at 10 cents, and with the production of aluminum thrown open to competition and the handicap of excessive cost thereby removed, there will certainly be a vast increase in the demand for the metal for electrical purposes.

THE PLATINUM SITUATION.—In a report to the Russian Minister of the Interior, filed in August, Lieutenant Ivan Alexandrovitch Lossiev says: "The platinum industry has grievously declined, and the depression has been so severe for the past year and a half that the price of platinum ore has declined to 4 roubles per solotnik of 83 per cent content of pure metal—that is to say, 15,360 roubles per pood [about $15 per ounce], whereas in October and November, 1906, it was 32,000 roubles per pood. It is expected that the decline will continue for some time, until all the small and medium platinum concerns in the Urals have been completely ruined. Even now, at present prices, many places in the northern Urals are being worked at a loss. The continuous decline in the value of platinum is due to the maneuvers of several groups or syndicates of foreign capitalists who are exerting every effort to get control of the Urals platinum industry (practically the only one in the world) in order to control the production and the market as well. The plan of the syndicates has apparently been to buy up all the government platinum areas available, and to buy in advance the production of all the large platinum houses. The plan has been realized to such an extent that now several platinum mines in the Treasury mining areas have already been bought by the syndicate, and the production of platinum in the mines of Count P. P. Schuvaloff, and also of the Nizhni-Tagilsk factories, the successors of Demidoff, Prince San Donato. Thus the syndicate already controls over 300 poods of platinum ore annually—that is to say, about 86 per cent of the total production of the Urals, which amounts to about 348 poods a year. In order to get possession of all the remainder, the syndicate has decided to kill the production of the remaining concerns by forcing down prices. The writer of the report pleads for the intervention of the government to protect the industry against the foreigner. It has been suggested that the government should prohibit the exportation of crude platinum, permitting only the exportation of refined metal; one result of which would be that the products of refining, namely, the iridium, osmium, ruthenium, palladium, etc., up to 10 to 15 per cent of which, notwithstanding their great value, is not separated from the platinum ore, and goes abroad unpaid for." Commenting on the statements contained in this report, Mr. Cyrus Osborne Baker, one of the leading importers and refiners of platinum in this country, had this to say: "This report does not correctly represent the condition of affairs in Russia either at the time the report was written, several months ago, or at present. It looks to me as if the report were written for the purpose of getting government aid. The price of platinum, of course, has been abnormally low during the period of depression in trade in this country and Europe, but this fact, in my opinion, has not been due to artificial pressure from any syndicate, but to the ordinary law of supply and demand. The production of metal has been about the same and the consumption has been very small; all branches of industry in which platinum is used have felt the hard times and there has been little demand for the metal. Prices declined to a low point in this country, but they have now recovered several dollars an ounce, and the present price is in the neighborhood of $22. Even at the low point, however, it was practically impossible to buy any quantity of metal. small lots could be picked up, but no heavy purchases could be made. The statement in this Russian report that the price has been depressed by the maneuvers of several groups or syndicates to get possession of the industry, in order to control the markets of the world, seems to me foolish. According to this statement the syndicates already control 86 per cent —which is not far out of the way—of the output they own —in fact, 300 poods out of a production of 348 poods. It does not seem likely that in order to bring loss to the owners of this 48 poods the syndicate would cut prices on its 300 poods. A control of 86 per cent is a practical monopoly, and I see no danger of prices being demoralized by a trade war. The truth of the matter is that the bulk of the platinum in Europe is held by the banks as collateral for loans. It is my opinion that these loans were generally made on a basis higher than the present price, and therefore I believe the price must necessarily advance as soon as the normal demand returns. The banks are not going to sell at a loss and outside of their holdings there is not enough to come anywhere near supplying the ordinary demand. So I do not think the platinum industry is in the unsatisfactory condition this report indicates, and I do not expect any price cutting with the view of establishing a monopoly."

WESTERN ELECTRIC PARIS CONTRACT.—The replacement of the destroyed Paris telephone switchboard mentioned recently in these pages, was completed Nov. 30. The $600 daily penalty clause in the contract for every day over 60 days required in building this switchboard was thus rendered inoperative. The Chicago plant of this company started work on the big switchboard Oct. 3, shipped it to New York on Oct. 23, and it arrived in Paris on the steamship *La Provence* Nov. 6. This is the second record made within a year by the Western Electric Company for rapid telephone exchange replacement, the other being that of the Antwerp exchange—the oldest in Europe—for which a 5000-line equipment was manufactured and installed in 30 days. The Paris contract covered a 10,000-line equipment, and while apparently involving but twice the labor of the other, in reality meant several times more.

GERMAN-AMERICAN ELECTRIC COMPANY. — A large installation of flaming-arc lamps has recently been completed by the German-American Electric Company, in the St. Louis Coliseum. The installation was made through the Grant Electric Company, of St. Louis, and consists of 26 lamps, 22 inside the building and four on the street. The building is a vast arena, somewhat similar to Madison Square Garden, and was lighted up for the public for the first time during the horse show in October. The lamps are 4000 cp each, and are all hung from the ceiling, diffusing the light equally over the entire space. Current is obtained from the Laclede Gas Light Company, and the consumption is claimed to be remarkably economical.

TO BUILD NEW VIRGINIA TRACTION LINE.—The Railway & Electric Construction Company, 30 Church Street, New York City, has just made a contract to build a traction line 9.2 miles long for the Accomack Traction & Power Company, in Accomack County, Virginia. The line will run from Onancock, via Tasley and Accomack to Metomkin Bay. It is expected to cost $175,000, and is to be completed next summer. A power house will be constructed at Metomkin Bay, with engine capacity of 300 hp and generators of 200 kw. The entire equipment will be contracted for by the construction company.

STONE & WEBSTER OPEN NEW YORK OFFICE.—The Stone & Webster Engineering Corporation, of Boston, has opened a branch office at 45 Cedar Street, New York City. The New York department will be in charge of Mr. Eliot Wadsworth, who has been connected with the company for a number of years. It will also be the headquarters for Mr. G. E. Tripp, who has been retained as special adviser to the reorganization committee of the Metropolitan Street Railway system.

RAILROAD SHOP MOTOR ORDER.—The Wabash Railroad Company has awarded to the Wagner Electric Manufacturing Company, of St. Louis, a contract for supplying the Ft. Wayne (Ind.) locomotive repair shops throughout with Wagner polyphase motors. Motors of from 10 to 40 hp capacity constitute this order, and they will be used for driving all kinds of machine tools. It seems to be quite the fashion to install Wagner motors in railroad repair shops.

WAPPINGER FALLS LIGHTING PLANT.—Bids will be opened Dec 15 for an extension of the Wappinger Falls municipal plant, for which $10,000 has been appropriated. Plans and specifications can be seen at Room 1002, Singer Building, New York.

Financial Intelligence.

THE WEEK IN WALL STREET.

The history of the stock market during the past week might be well described as colorless. There were ups and downs on alternate days, and the net changes for the week were about equally divided between fractional gains and losses. Trading was not exceedingly active, nor was it noticeably dull. In other words, there is little to say about the market that is indicative of what may be expected in the future or that develops any

pronounced tendency. Public buying is still very small, but there is a considerable amount of dealing among the regular traders, and the clique which has been responsible for the bull movement seems to be always on hand ready to check any effort that may be made to seriously depreciate prices. Among the rumors of the week—and this is given entirely as a rumor—is one to the effect that these insiders, who have been behind the upward movement which began last Spring, intend to hold the market steady with a buoyant tendency until well into January, when there will be a great hurrah and splurge, possibly some sky-rocketing, and the campaign will be ended. Whether we are to understand from this rumor that the insiders intend to make a market upon which they may unload their holdings it is hard to say, but as the story itself has very little better foundation than the idle talk that goes on around the ticker when orders are few, it is hardly worth while to be alarmed over the situation. There is undoubtedly some check to business in Wall Street on account of the tardiness with which general commercial business has been resumed. It is commonly believed at this time that the agitation of the tariff question is responsible for this conservatism in industrial and commercial lines. No manufacturer wants to go in very heavily, no wholesaler wants to buy very largely, no retailer wants to stock up too extensively when there is a possibility that a sweeping reduction in the tariff schedule may demoralize prices. It is not so much a question as to whether our industries can thrive with a lower tariff rate or not, but it is the disturbing

NEW YORK.

	Nov. 30.	Dec. 7.	Shares sold.		Nov. 30.	Dec. 7.	Shares sold.
All.-Ch.	14¾	15⅛	11,700	Int.-Met., pfd...	35	36	11,650
All.-Ch., pfd....	48¾	48⅞	17,350	Mackay Cos....	75½	75⅛	1,220
Amal. Cop.	84¾	83⅛	110,000	Mackay Cos.,pfd.	71	70¾*	300
Am. D. T.....	35*	35*	——	Manhattan Elev.	147	149⅝*	3,570
Am. Loc.	56	55¼	8,181	Met. St. Ry....	30	30*	400
Am. Loc., pfd.	110*	109½	370	N.Y. & N.J.Tel.	122*	112*	380
Am. Tel. & Cbl.	75½*	78*	300	Steel, com.....	55⅛	54¼	622,050
Am. T. & T....	128¾	128½	21,570	Steel, pfd.	112¾	112½	14,680
B. R. T.....	55	55⅛	53,800	W. U. T.....	70	69¾	6,500
Gen. Elec.....	160	157	20,620	West'h., com...	91¼	90⅜	7,450
Int.-Met., com..	14½	14¾	25,575	West'h., pfd....	125*	115	200

PHILADELPHIA.

	Nov. 30.	Dec. 7.	Shares sold.		Nov. 30.	Dec. 7.	Shares sold.
Am. Rys.	46½	46*	——	Phila. Elec. ...	11⅜	11	——
Elec. Co. of A..	10¾	10¾	——	Phila. R. T....	22½	21¾*	——
Elec. Stor. B'ty.	43	42	——	Phila. Traction..	90	90	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction..	49½	50	——

CHICAGO.

	Nov. 30.	Dec. 7.	Shares sold.		Nov. 30.	Dec. 7.	Shares sold.
Chi. City Ry...	176*	180*	——	Chi. Tel. Co....	130	129	——
Chi. Rys., Ser.1.	117	118*	——	Met. El., com...	13*	16*	——
Chi. Rys., Ser.2.	45	44*	——	Nat'nal Carbon.	83*	86*	——
Com. Edison...	105¼	106	——	Nat. Carb., pfd.	113*	112*	——
Chi. Subway...	22	25	——				

BOSTON.

	Nov. 30.	Dec. 7.	Shares sold.		Nov. 30.	Dec. 7.	Shares sold.
Am. Tel. & Tel.	128¾	128⅝	——	Mass. E. R.,pfd.	60¼	58¾	——
Cum. Tel.	127	127¾	——	Mex. Tel.	3*	2	——
Gen. Elec.	159½	159½*	——	Mex. Tel., pfd.	5½*	5½	——
Edison El. Ill...	251	251*	——	N. E. Tel'p....	126	125	——
Mass. Elec. Ry.	13	12	——	W. Tel. & Tel..	9⅛*	7⅜	——
				W. T. & T., pfd.	78½*	78½*	——

*Last price quoted.
Shares sold are for week Nov. 30 to Dec. 5.

effect of uncertainty as to what the rate may be next Summer or next year. The call for money during the week has been rather brisker than at any time in recent months. This is due to several causes other than an increase in the borrowing for business purposes. In the first place, a considerable amount of American securities which had been held in Europe have recently been disposed of in this market. Such sales, of course, create a demand for exchange, and this demand has been shown in the fact that a million-and-a-half of gold was exported during the week. It is also a well-known fact that the Bank of France is seeking to accumulate gold, thus adding to the drain upon the resources of our banks. During the week the rate for call money advanced to 3 per cent—a figure which has not been touched but once since the first of last January. This increase in the demand for money, however, has apparently had no effect upon the greediness with which bonds are taken. Every large issue that is offered is over-subscribed, and there always seems to be plenty of money for any security that comes in the shape of a mortgage, whether it be industrial or railroad. This shows that there is a surplus of cash in the country ready for investment, and that the only reason that it does not pour into the stock market is because the people who have it are not yet thoroughly satisfied with the safety of such investment. The money market on Dec. 7 was 2@2½ per cent for call money and 3@3¼ for 90 days. The quotations in the table are at the close Dec. 7.

DIVIDENDS.

Interborough Rapid Transit Company, New York, N. Y., quarterly, 2¼ per cent, payable Jan. 2.

Twin City Rapid Transit Company, Minneapolis, Minn., preferred, quarterly, 1¾ per cent, payable Jan. 2.

Butte Electric & Power Company, Butte, Mont., common, quarterly, 1½ per cent, payable Jan. 2.

Chicago (Ill.) City Railway, quarterly, 1½ per cent, payable Dec. 30.

Wilkes-Barre (Pa.) Gas & Electric Company, quarterly, 1 per cent, payable Jan. 2.

Ingersoll-Rand Company, Chicago, Ill., preferred, semi-annual, 3 per cent, payable Jan. 2.

Safety Car Heating & Lighting Company, New York, N. Y., quarterly, 2 per cent, and extra 1 per cent, both payable Dec. 23.

Guggenheim Exploration Company, New York, quarterly, 2½ per cent.

Chicago (Ill.) Telephone Company, 2 per cent, payable Dec. 31.

Laclede Gas Light Company, St. Louis, Ill., preferred, semi-annual, 2½ per cent., payable Dec. 15.

Laclede Gas Light Company, St. Louis, Mo., common, quarterly, payable Dec. 15.

Chicago & Northwestern Railway, Chicago, Ill., preferred, quarterly, 2 per cent, payable Jan. 2.

Chicago & Northwestern Railway, Chicago, Ill., common, semi-annual, 3½ per cent, payable Jan. 2.

CHICAGO CONSOLIDATED TRACTION COMPANY.—The receivers of the Chicago (Ill.) Consolidated Traction Company have been authorized to borrow $200,000 for rehabilitation, pledging receipts until 1910. The Harris Trust & Savings Bank, Chicago, has formed a bondholders' protective committee for the company's underlying bonds, and deposits are requested of such issues as the Chicago Electric Transit Company, North Chicago Electric Railway, North Side Electric Street Railway, Chicago North Shore Electric Street Railway.

WESTINGHOUSE RECEIVERS DISCHARGED.—It is very satisfactory to note that the receivers of the Westinghouse Electric & Manufacturing Company and the Securities Investment Company were discharged in the United States Circuit Court at Pittsburg on Dec. 5, by Judge James S. Young. Petitions for the discharge of the receivers were presented to the court by Mr. George Gordon, representing the various consenting interests. The debts of the company, as previously stated in these pages, have been arranged for, with the exception of unassenting creditors with claims to the amount of $700,000, who will at once be paid in cash. The company has cash on hand amounting to about $15,000,000. The cash of the Securities Investment Company on hand is about $17,000,000, with unassenting creditors representing only about $15,000. As the receivers had reported the condition of the plant from time to time to the company, the court did not deem it necessary that they file another account, as it would interfere with the work of the corporation, busy with its new plans and large contracts. The newly-elected directors of the company met and organized on Dec. 7. Practically the only change in the management, as it stood before 1907, was the election of Mr. E. C. Converse as temporary chairman of the board, in place of Mr. Brayton Ives, the former chairman. The officers of the company are: Mr. George Westinghouse, president; Mr. E. M. Herr, first vice-president; Mr. L. A. Osborne, second vice-president; Mr. Charles A. Terry, secretary and attorney; and Mr. T. W. Siemon, treasurer. Mr. G. W. Hebard and Mr. W. M. McFarland were also elected vice-presidents. This is the familiar and veteran Westinghouse organization as to its personnel.

COLUMBIA POWER, LIGHT & RAILWAY COMPANY.—The Columbia Power, Light & Railway Company, Bloomsburg, Pa., has been organized to hold the stock and bonds of the Columbia & Montour Electric Railway, the Danville & Bloomsburg Street Railway, the Irondale Electric Light Company, the Berwick Electric Light Company, the United Gas & Electric Company, the Standard Gas Company and the Standard Electric Company, embracing all the electric and gas companies in Columbia and Montour counties on the north branch of the Susquehanna River. It is the purpose to generate part of the current needed by the new company at the plant of the

Irondale Electric Light Company at Bloomsburg and the rest at the plant of the Harwood Electric Company at Hazelton, Pa. Edward R. Sponsler, Harrisburg, Pa., H. W. Hamblin, formerly of the Paxtang Electric Company, Harrisburg, and A. W. Duy, of the United Gas & Electric Company, Bloomsburg, arranged for the merger. The Columbia Power, Light & Railway Company will issue a total of $2,500,000 in bonds, preferred stock and common stock.

ROCKINGHAM (N. C.) POWER COMPANY RECEIVERSHIP.—Upon application of the S. Morgan Smith Company, of York, Pa., manufacturers of hydraulic apparatus, receivers have been named by the United States Court for North Carolina for the Rockingham Power Company, which has headquarters at Wilmington, N. C. The Smith Company is a creditor for machinery furnished and is in addition holder of a large number of the company's bonds. The complaint alleges that there has been dissention in the management of the company and that the credit of the organization has been impaired. The court appointed W. H. Browne, who has been general manager of the company, and W. A. Leland, who has been in charge of the construction work, as receivers. The bondholders, several months ago, appointed a reorganization committee, which has been formulating plans for securing additional capital for the completion of the work.

HUDSON RIVER ELECTRIC POWER COMPANY.—Judge Ray, in the Federal Court, on Dec. 3, reserved decision on the application to appoint separate receivers for the subsidiary companies of the Hudson River Electric Power Company. The application to issue receivers' certificates to pay interest on the company's underlying bonds made by the Hudson River Power Transmission Company was referred to a special master to take testimony and report to the court. A lease of the company's steam plant at Utica, N. Y., to the Utica & Mohawk Valley Railway, to continue pending the receivership, is said to have been arranged. For some time the Utica & Mohawk Valley Railway has been operated from this plant.

CHICAGO & MILWAUKEE ELECTRIC RAILROAD.—Judge Grosscup, of the Court of Appeals, has reappointed the receivers of the Chicago & Milwaukee Electric Railroad, Chicago, Ill., with enlarged duties and has consolidated the foreclosure suits. He says that the reorganization plan will probably be drafted immediately. Holders of $8,500,000 of the $10,000,000 bonds have approved the reorganization.

HUDSON RIVER TELEPHONE COMPANY.—The stockholders of the Hudson River Telephone Company and the New York & Pennsylvania Telephone & Telegraph Company are offered the privilege of exchanging their stock for stock of the Bell Telephone Company of Pennsylvania on the basis of one share of stock of the Bell Telephone Company of Pennsylvania for two shares of stock of the New York & Pennsylvania Telephone Company, and on the basis of one share of stock of the Bell Telephone Company of Pennsylvania for 1½ shares of stock of the Hudson River Telephone Company.

NORTH AMERICAN COMPANY TO RESUME DIVIDENDS.—It is reported that the North American Company is likely to resume dividend payments early in the coming year at the same rate as prior to the discontinuance of annual dividends in December, 1907, namely, 5 per cent. It is stated that the company's earnings have at no time fallen below the amount necessary for paying a 5 per cent dividend, the discontinuance of payments being due to financing an issue of short term notes of the Union Electric Light & Power Company of St. Louis.

MEXICAN LIGHT & POWER COMPANY.—The directors of the Mexican Light & Power Company, Mexico City, Mex., at the request of 25 per cent of the stock, have called a meeting of the stockholders for Dec. 30, to vote to lease the property to the Mexico Tramways. The lease would provide a rental sufficient to cover 4 per cent dividends on the common stock of the Mexican Light & Power Company, and 7 per cent on the preferred stock and interest on the bonds; any surplus would be divided between the companies on a specified basis.

MICHIGAN LAKE SUPERIOR POWER COMPANY.—More than 90 per cent of the bonds of the Michigan Lake Superior Power Company, Sault Ste. Marie, Mich., have been deposited with the bondholders' committee. This insures, it is stated, the carrying out of the committee's plan for the readjustment of the company's affairs.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—Application has been made to the New York Stock Exchange by the Westinghouse Electric & Manufacturing Company to list $4,531,000 additional convertible sinking fund 5 per cent bonds, due 1931, and $9,560,000 additional assenting stock.

NEBRASKA TRACTION & POWER COMPANY.—The Nebraska Traction & Power Company, Omaha, Neb., has filed a mortgage for $1,330,000 in favor of the Midland Guarantee & Trust Company, Omaha, as trustee, to secure a proposed bond issue.

NEW BERN LIGHTING & FUEL COMPANY.—The property of the New Bern Lighting & Fuel Company, New Bern, N. C., was bid in at receiver's sale on Nov. 23 by W. S. Smallwood for $40,000.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Berkshire Street Railway, Pittsfield, Mass.:					
Year ended September 30, 1908	$404,818	$295,434	$109,384	$109,439	*$55
Year ended September 30, 1907	405,137	294,266	110,871	112,464	*1,592
Boston Suburban Electric Companies, Newton, Mass.:					
Year ended September 30, 1908	793,206	567,354	225,852	†250,057	*24,205
Year ended September 30, 1907	244,910	56,420	188,490	†141,357	47,133
Cumberland Telephone & Telegraph Company, Nashville, Tenn.:					
October, 1908	516,380	283,447	232,933	44,410	188,523
October, 1907	508,249	303,837	204,412	37,998	166,414
Kansas City (Mo.) Railway & Light Company:					
October, 1908	575,281	313,041	262,240	156,822	105,418
October, 1907	559,822	271,191	288,632	153,575	135,057
Massachusetts Electric Companies, Boston, Mass.:					
Year ended September 30, 1908	7,809,010	5,001,517	2,807,492	1,784,437	1,023,054
Year ended September 30, 1907	7,758,511	5,000,652	2,757,858	1,702,622	1,055,235
Norfolk & Portsmouth Traction Company, Norfolk, Va.:					
October, 1908	156,795	88,316	68,479	.....	.....
October, 1907	257,515	158,954	98,561	.....	.....
Syracuse (N. Y.) Rapid Transit Company:					
Year ended June 30, 1908	1,312,291	822,197	470,689	334,606	155,488
Year ended June 30, 1907	1,176,767	686,515	483,262	295,180	195,071
United Traction Company, Albany, N. Y.:					
Year ended September 30, 1908	560,693	302,187	218,492	98,877	159,629
Year ended September 30, 1907	586,505	324,170	225,106	87,481	174,854
Worcester (Mass.) Consolidated Railway:					
Year ended September 30, 1908	1,626,143	1,045,293	580,850	375,722	205,128
Year ended September 30, 1907	1,641,264	1,083,077	558,187	362,154	196,033

* Deficit. † Includes dividends.

GENERAL NEWS

Construction News.

COLUMBIA, ALA.—Arrangements are being made by A. D. Wood, of Columbia, Ala., for the erection of a cotton mill at an expenditure of about $30,000. The plans include the construction of a dam which will develop 1000 hp and the installation of an electric power plant.

EUFAULA, ALA.—The City Council is considering the question of installing a municipal electric light plant and has authorized the appointment of a committee to investigate the cost of a new plant.

JUNEAU, ALASKA.—Extensive improvements are contemplated at the Perseverance Mine, at Juneau, during the winter, which will include the installation of a Weber gas plant to generate electricity to operate the machinery at the mines, when the water supply is exhausted. J. R. Mitchell is manager.

ARGENTA, ARK.—The municipal electric plant will be dedicated Dec. 31. The Little Rock Light Company, which formerly furnished electricity in Argenta, is taking down wires and taking out meters as fast as they are cut out by Argenta patrons.

FAYETTEVILLE, ARK.—The City Council of Fayetteville, Ark., has granted a franchise to Louis Moulton, of Boston, and others for electric street car lines. The railway will extend from Silvan Springs to Huntsville, work on which will begin in 30 days.

HAZEN, ARK.—Plans are being made by Alvin V. Harris to install an electric light plant in connection with his cotton gin.

LITTLE ROCK, ARK.—The reorganization of the Central Arkansas Electric Railways Company is said to be under way. About 100 miles of interurban line will be built, it is said. The line will run from Little Rock, Ark., south to a point near Sheridan, Ark., where it will divide, one branch leading to Hot Springs, the other to Pine Bluff.

BERKELEY, CAL.—The Board of Trustees has granted the San Francisco, Oakland & San Jose Consolidated Railway Company a franchise for several new extensions on certain streets in Berkeley.

ESCONDIDO, CAL.—The stockholders of the Escondido Mutual Water Company have voted to install an electric lighting and power plant, at a cost of $30,000. Water supply for the valley is taken from the San Luis River, about 15 miles from Escondido, which is conveyed through conduits, ditches and tunnels to the reservoir about seven miles east of the valley, where it is proposed to erect the power plant. It is proposed to furnish electricity for lamps and motors to the stockholders of the company.

LA GRANGE, CAL.—The La Grange Water & Power Company contemplates installing an additional 450-kw unit and exciter and another water wheel in its plant; also transformers to transform the current from 40,000 to 33,000 volts. John Coffee Hayes is vice-president and manager.

OCEAN PARK, CAL.—The Los Angeles-Pacific Company has been granted a franchise by the Board of Trustees for an extension of its railway.

OXNARD, CAL.—The Bakersfield & Ventura Railroad Company is planning to build two miles of track in Oxnard to fulfil the terms of the franchise granted the company. T. B. Blackburn is general superintendent.

POMONA, CAL.—The Pacific Electric Company has applied for a franchise to construct an electric railway around the east side of Ganesha Park.

SONORA, CAL.—Work has commenced on the construction of the transmission line of the La Grange Power Company to Turlock. The line will be about 32 miles in length and will be completed in about three months.

DENVER, COL.—The Denver Gas & Electric Company contemplates extensive improvements to its system this year, which will involve an expenditure of about $1,000,000. The west side electric station, the Lacombe plant and the station near the Union Depot will all be enlarged and new electrical equipment has been ordered. Contracts have also been placed for a new gas holder with a capacity of 3,000,000 gal. Frank W. Frueauff is general manager.

WHITNEYVILLE, CONN.—The Whitneyville Improvement Association has voted to adopt 60-cp electric lamps for lighting the streets. A contract has been awarded for a term of three years at $1,650.

FAIRBURN, GA.—Preliminary surveys are being made by the Fairburn & Atlanta Railway & Electric Company for its proposed electric railway, which will connect Fairburn, Union City, Stonewall, Red Oak, College Park and Atlanta. W. T. Roberts, of Fairburn, is president of the company.

BOISE, IDAHO.—The Boise & Interurban Railroad Company contemplates extending its city line a distance of 1¼ miles. The company is also planning to double track the railway to Pierce Park and to make a number of improvements to the park.

HADEN, IDAHO.—Julian M. De Coster, of Haden, and Fred T. Mitchell are interested in a project to develop the water power of Teton River. A company has been organized under the name of the Teton River Power Company, which has secured rights to a 156-ft. fall of water in Teton River.

PONDERAY, IDAHO.—An agreement has been entered into with the Sandpoint Light & Power Company, Sandpoint, Idaho, to supply the town with water and electricity for lamps.

TWIN FALLS, IDAHO.—It is reported that orders have been received from Pittsburg, Pa., to extend the transmission line from Jerome to Wendell. It is understood that the company will extend the transmission line to the lower Salmon Falls, where a power plant will be installed this winter by the North Side Company.

OLNEY, ILL.—The plant of the Olney Electric Light & Power Company was destroyed by fire Dec. 1, causing a loss of $24,000.

ROCK ISLAND, ILL.—Active work has commenced on the construction of the new electric railway of the Rock Island Southern Railroad Company, which will connect Rock Island with Monmouth and Galesburg, Ill., and Burlington, Ia. The cars will be equipped with alternating-current motors. The management contemplates the purchase of 18 cars in the near future. The overhead catenary equipment for the road has been purchased from the Ohio Brass Company. It is designed for 11,000 volts. Plans have not been completed for power for operating the railway, but it is stated that the transmission system will be designed for 44,000 volts.

WAUKEGAN, ILL.—Plans are being made for the construction of an electric railway to connect Elgin, Rockford and Waukegan, with the lake regions of northern Illinois and southern Wisconsin. A company will be organized under the name of the Waukegan, Rockford & Elgin Traction Company. The cost of the railway is estimated at $1,000,000. Robert Wynn, of Waukegan, Ill., is interested in the project.

BERNE, IND.—The Bluffton, Berne & Celina Traction Company, recently organized, is making preliminary arrangements to construct an interurban railway from Bluffton to Celina via Berne.

DANVILLE, IND.—The Danville Light, Heat & Power Company has filed a notice of an increase of capital from $36,000 to $100,000, the proceeds to be used to enlarge the plant and install modern equipment.

FT. WAYNE, IND.—The work of installing electric motors in the Wabash railway shops is being pushed rapidly, and it is expected that the shops will be equipped to be operated by electricity by Jan. 1.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has prepared plans for remodeling its power station in Lafayette, Ind. When completed the equipment will be removed from the old station at Huntington. At present the power house supplies electricity in Lafayette and for the Battle Ground branch line.

FT. WAYNE, IND.—The Municipal Electric Light Board is advising residents to form clubs, with a view to purchasing electricity from the city. These clubs are formed so that all the users of electricity in a given district shall ask for electrical service from the municipal plant at one time. In this way a single large transformer, which will supply energy for 300 or 400 lamps, can be used for the entire district. The traction company, which has a franchise to sell electricity in the city, states that there will be a cutting of rates after the first of the year. The city has made a rate of eight cents per kw-hour and will depend on the loyalty of consumers to support the municipal plant, no matter how much the traction company may cut under this rate.

FRANKFORT, IND.—This city is putting in a duplicate electric light plant and has contracted to extend the wires to the town of Mulberry, a distance of six miles, and will supply the town with electricity for street and domestic lighting.

INDIANAPOLIS, IND.—The Board of Public Safety is in the market for two electric hose wagons for the fire department.

LINTON, IND.—The City Council has declared against the proposition to sell the municipal electric light plant and will proceed with the arrangement to enlarge the plant and will install new boilers, dynamos and other mechanical equipment.

NEW CASTLE, IND.—The City Council has awarded a contract to the John A. Stuart Company, of Cincinnati, Ohio, to install an engine, generator and other equipment in the city electric light plant.

DES MOINES, IA.—The contract for the construction of the proposed electric railway from Des Moines to Sioux City, Ia., a distance of 196 miles, has been awarded to the American Engineering Company, Terminal and Traction Building, Indianapolis, Ind. The railway is being built by a syndicate of Iowa bankers, who have organized under the name of the Des Moines & Sioux City Railway Company. When the railway is completed it is proposed to build a branch road to Fort Dodge and also from Souix City to Council Bluffs and Omaha, a total distance of approximately 60 miles, and from Council Bluffs to Des Moines, a distance of 150 miles. Charles N. Wilson is president of the American Engineering Company.

McCALLSBURG, IA.—A new switchboard is to be installed in the local telephone exchange.

SIOUX CITY, IA.—The Sioux City & Spirit Lake Interurban Electric Railway Company has been granted franchises by the City Councils of Spirit Lake, Hartley, Primghar, Paulina and LeMars, giving the company permission to operate its proposed railway and electric light and power system in the above named cities. The railway will be 110 miles in length. The contract for building the railway has been awarded to Westinghouse, Church, Kerr & Company, of New York, N. Y. Fred Davis is secretary.

LAWRENCE, KAN.—Arrangements are being made to construct an electric railway in this city which will eventually be extended to Kansas City and Topeka. As soon as the local system is completed the railway will be extended to Kansas City and Topeka. It is reported that J. F. Shaefer, an electrical engineer, is to furnish the electrical equipment of the road. The promoters are: W. R. Stubbs, governor-elect of Kansas; J. E. Stubbs; M. E. Lowe, of Lawrence, Kan.; Albert Henley, Charles Sutton and R. C. Johnston, all of Lawrence, Kan.

FRANKFORT, KY.—Bids will be received at the office of the Board of State Capitol Commissioners, Frankfort, Ky., until Jan. 5 for furnishing and installing the electric light fixtures required in the new State capitol at Frankfort, Ky. Plans and specifications may be seen at the offices of the architects, Frank M. Andrews & Company, Cincinnati, Ohio, and Waldorf-Astoria, New York, N. Y.

GREENVILLE, MAINE.—The Greenville Light & Power Company contemplates extending its transmission line to Monson, Maine, to furnish electricity for motors to the slate works in that village. The company will also furnish electrical service in the town of Monson.

LIMERICK, MAINE.—The new dam of the Limerick Water & Power Company, located at "The Ledges," three miles from Limerick, will soon be completed. The plant will furnish electricity to operate the Limerick Mills.

OAKLAND, MAINE.—The new 60-hp Hamilton engine has been installed in the power house of the Waterville & Oakland Street Railway for use during the low water periods and also as an auxiliary to the water plant. A new generator will soon be installed to be connected to the new engine.

SEARSPORT, MAINE.—The Penobscot Bay Electric Company, of Rucksport, Maine, has applied to the Selectmen for permission to erect transmission lines on the county road from Stockton line through Searsport to the city of Belfast.

BALTIMORE, MD.—Arrangements are being made for building the extension to the underground conduit system, for which $1,000,000 was recently appropriated. Plans will be completed about Jan. 1. C. E. Phelps is chief engineer of the Electrical Commission.

HAGERSTOWN, MD.—The Antietam Electric Light & Power Company, which is constructing an electric plant on the old Delamere Mill property on Antietam Creek, near Breathedsville, is negotiating with the officials of the towns of Sharpsburg and Keedysville to furnish electricity to light the towns. The company has a contract to supply electricity to light Boonsboro.

GLOUCESTER, MASS.—The Gloucester Electric Company has petitioned the Massachusetts Gas & Electric Light Commission for approval of the issue of $60,000 additional capital stock.

GREENFIELD, MASS.—Arrangements are being made by the Greenfield Electric Light & Power Company to separate its lighting and power circuits by the erection of new lines. The cost of the work is estimated at from $4,000 to $5,000.

HYDE PARK, MASS.—The citizens have petitioned the Gas & Electric Light Commission for a reduction in the rates charged for electricity by the Hyde Park Electric Light Company. A hearing will shortly be assigned.

LEE, MASS.—The Smith Paper Company has entered into a contract with the Lee Electric Company to furnish electricity for lamps for the Columbia, Centennial and Niagara Mills.

BAY CITY, MICH.—The Valley Telephone Company has submitted an ordinance to the City Council asking for a new franchise to run for 30 years and for certain concessions with regard to rates. The present franchise runs for 17 years, and the company asks that it be extended for 13 years more. It is said that the company contemplates making improvements to its property, including the installation of underground work and other extensions.

DOWAGIAC, MICH.—The City Council has granted the Dowagiac Railway Company a 30-year franchise to operate a street railway system in this city. The promoters of the project are operating a railway from Benton Harbor to Eau Claire, Mich.

ESCANABA, MICH.—The Escanaba Electric Pulp & Power Company has been reorganized under the name of the Escanaba Power Company, and the following officers elected: P. L. Utley, of Escanaba, Mich., president; J. M. Molloy, of Watertown, Mich., vice-president, and M. N. Smith, of Escanaba, secretary and treasurer. The company has decided to construct a second dam in Escanaba River, near Groos, next season. The power will be used to operate a pulp board plant and other industries.

FARWELL, MICH.—The Village Council is considering the question of bonding the village to the amount of $3,000 to install an electric street lighting system.

GRAND LEDGE, MICH.—The capital stock of the Grand Ledge Telephone Company has been increased from $25,000 to $50,000.

GRAND LEDGE, MICH.—The city has decided to sell the equipment of the municipal electric light plant. Electrical energy for operating the lighting system will be supplied by the Commonwealth Power Company, of Jackson, Mich. The city contemplates installing two centrifugal electrically driven, direct connected pumps in connection with the water works system.

IRON MOUNTAIN, MICH.—A special meeting of the stockholders of the Iron Mountain Electric Light & Power Company will be held Dec. 12 to consider the proposition of purchasing a water power and installing a hydro-electric power plant. The company contemplates purchasing what is known as the Michigan side of the lower Twin Falls. Estimates covering the cost of the proposed plant have been submitted by Thomas W. Orbison, of Appleton, Wis., hydraulic engineer, in which he states that a plant can be erected with an output of more than 500 hp at an expense less than $50,000.

PINCONNING, MICH.—The Eastern Michigan Power Company has been granted a 30-year franchise in Pinconning to erect its transmission lines through the town. The company is planning to extend its system in most of the towns along the Detroit & Mackinac and Michigan Central Railroads to furnish electricity for lamps and motors.

NORTH REDWOOD, MINN.—The installation of an electric light plant in North Redwood is under consideration.

ST. PAUL, MINN.—Specifications for street lighting as prepared by the Board of Public Works and presented to the Board of Aldermen call for the installation of 2000 additional lamps during the coming year.

YAZOO CITY, MISS.—Bids will be received by W. F. Cummins, city clerk, until Dec. 14 for leasing for 10 years an electric street railway in Yazoo City, owned and built by the city. The road is nearly completed.

INDEPENDENCE, MO.—The City Council is considering the proposition of turning the municipal electric light plant over to a non-partisan board. W. F. Lyons, of Kansas City, Mo., has submitted a proposition to the Council with a view of leasing the plant on a percentage basis and conducting it as a private enterprise.

KANSAS CITY, MO.—The main power plant of Swift & Company is reported to have been destroyed by fire, causing a loss of about $40,000.

KANSAS CITY, MO.—Plans are being made for the construction of a new electric railway from Kansas City to Excelsior Springs. The project is being promoted by E. L. Morse, of Excelsior Springs, Mo., and others. The enterprise has been capitalized at $1,600,000.

BILLINGS, MONT.—It is reported that the merchants and business men of Billings have taken up the proposition to construct an electric railway to Laurel, a distance of 16 miles, and have agreed to secure subscriptions to the amount of $100,000 in stock of the Billings & Cooke City Railway Company. Electrical energy for operating the road will be furnished by plants located on the Yellowstone River and from the power plant of the Madison River Power Company.

LEWISTOWN, MONT.—The East Fork Telephone Company is considering the extension of its telephone lines.

PHILLIPSBURG, MONT.—The owners of the local electric light plant, which has been closed for 18 months, are negotiating with the City Council for a contract for lighting the streets of the city, and, if granted, will open the plant. A new gasoline engine will be installed to replace the old steam equipment. The plant will be operated by Owens Brothers.

WHITCOMB, MONT.—The Malta-Zortman Company, of Malta, Mont., contemplates establishing a telephone exchange in Whitcomb.

McCOOK, NEB.—The McCook Electric Light Company is planning to construct a new electric plant, to be equipped with a steam turbine unit. The cost of the plant is estimated at $35,000.

ATLANTIC, N. J.—An agreement has been made between the wire-owning corporations and the city whereby all wires will be placed in underground conduits. The Atlantic City Electric Company, which has the contract for municipal lighting, will expend about $300,000 in installing an underground conduit system.

RUTHERFORD, N. J.—Bids will be received by the Borough Council until Dec. 11 for lighting the streets and public places of the borough for a term of one, three and five years as follows: 1. For incandescent lamps of 25 cp each. 2. For electric arc lamps of 2000 cp each. The present street lighting system consists of 305 incandescent electric lamps and 55 arc lamps. Frank A. Stedman is borough clerk.

BUFFALO, N. Y.—Plans are being considered by the Niagara, Lockport & Ontario Power Company for the erection of another transmission line in this part of the State. The plans call for the construction of another penstock for the passage of water at Niagara Falls. The conduit will be about a mile in length, and will cost about $750,000.

CANAJOHARIE, N. Y.—The Board of Trustees has awarded the contract for constructing a 15-duct conduit in Church Street, Canajoharie, to F. W. Schuyler, of Fort Plain, N. Y., for $2,721.

FLORAL PARK, N. Y.—The Village Board has awarded the contract for lighting the streets of the village by electricity to the Nassau Light & Power Company. The company will furnish 30-cp tungsten lamps at the rate of $20 per lamp per year.

GHENT, N. Y.—The Town Board of Ghent has decided in favor of the lighting district proposition, and has placed contracts with the Chatham Electric Light, Heat & Power Company, of Chatham, N. Y., for lighting

the main road between Ghent and Chatham, a distance of one and one-half miles. The company will also furnish electricity for commercial and residential lighting.

GOWANDA, N. Y.—The contract for remodeling the electric plant at the Gowanda State Hospital, Gowanda, N. Y., was awarded to Frost & Sheldon, Albany, N. Y., for about $5,000.

LA SALLE, N. Y.—The citizens are circulating a petition, which will be presented to the Public Service Commission, asking for improved lighting service and for extension of the service from 12 to 24 hours. The Niagara Falls Gas & Electric Company, of Niagara Falls, furnishes the present service.

NEW YORK, N. Y.—Bids will be received by the Park Board at the office of the Department of Parks, Arsenal Building, Fifth Avenue and Sixty-fourth Street, New York, N. Y., until Dec. 17, for furnishing and installing electric work in the department shops and stables, located on the Eighty-sixth Street Transverse in Central Park. Plans may be seen and blank forms may be obtained at the above office. Henry Smith is president of board.

NEW YORK, N. Y.—Plans have been filed by Axel S. Hedman, architect, acting for Receiver Frederick W. Whitridge, for a new power house to be erected for the Union Railway Company on Brook Avenue, north of 165th Street, at a cost of $30,000.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has decided to equip its Commercial Street power plant with oil-burning apparatus for emergency use.

ROCHESTER, N. Y.—Surveys are being made by the Rochester & Manitou Beach Railroad Company for an extension of its railway from Manitou Beach to Hilton. Surveys have also been made to the light-house at Devil's Point, where the company may also extend the railway.

ROCHESTER, N. Y.—Surveys have been made and plans drawn for the proposed new electric railway of the Rochester & Honeoye Valley Railway Company, which will extend from East Rush to Atlanta. John S. Rockwell, Edward P. Lupfer and Harrison H. Reed, of Honeoye, N. Y., are interested in the project.

ROCHESTER, N. Y.—The Adler Brothers Company has engaged Charles A. Alexander, consulting engineer, to take charge of the installation of the power plant at its factory, 92 St. Paul Street, Rochester, N. Y. The boiler plant will have a rating of from 800 to 1000 hp and will furnish steam for both heating and power. The equipment of the generating plant will include two or three direct-connected units with a rating of 200 hp. All the larger machines will be motor driven and the smaller machines will be grouped to motor-driven line shaft. Bids will be received until Dec. 15 by Max Adler for machinery and building.

STITTVILLE, N. Y.—The citizens are considering the question of establishing an electric lighting service for the village.

WAPPINGER FALLS, N. Y.—Bids will be received until Dec. 15 for extensions to the municipal electric light plant, for which an appropriation of $10,000 has been made. Plans and specifications can be seen at the office of Gustave Monrath, electrical engineer, 1002 Singer Building, New York, N. Y.

ASHEVILLE, N. C.—The contract for the construction of the first section of the new electric railway from Asheville, N. C., to Greenville, S. C., has been awarded to the Carolina Construction Company. Col. V. E. McBee is president of the Carolina Construction Company.

BURLINGTON, N. C.—Plans are being considered by the City Light & Power Department to change the municipal electric plant from single-phase to three-phase for the day power circuit. O. P. Dickson is manager.

CHARLOTTE, N. C.—The Southern Power Company, of Charlotte, N. C., has awarded the contract for the construction of a large dam across Broad River at Ninety-nine Islands, S. C., to B. H. Hardaway, of Columbus, Ga., for $650,000. The dam will furnish power to operate a 16,000-hp electric plant.

CHARLOTTE, N. C.—The property and holdings of the Carolina Valley Railroad, only partially built, from Thomasville to Denton, a distance of 30 miles, were sold at auction Nov. 30 to L. B. Jones and W. T. Van Brunt, of New York, N. Y. The charter and rights of way of the North Carolina Electric Company, between High Point and Thomasville, were sold to E. D. Steele and W. T. Van Brunt, of New York, N. Y. The purchasers state that both projects will be completed.

FREMONT, N. D.—The independent telephone companies in the third district contemplate erecting copper toll lines between Fremont and Columbus, Columbus and Norfolk and Creston and Madison. Plans are also being considered for extending the telephone lines to Grand Island and to points on the Union Pacific branch lines from Columbus.

EAST LIVERPOOL, OHIO.—The contract for street lighting has been awarded by the City Council to the East Liverpool Traction & Light Company for five years after Jan. 1, 1909. The company is to furnish arc lamps at the rate of $66 per lamp per year and incandescent lamps of 80 cp at $34 each per year.

FINDLAY, OHIO.—The contract for street lighting has been awarded to the Toledo Urban & Interurban Railway Company at $65 per lamp per year instead of $69.50, the rate paid last year.

LIMA, OHIO.—Bids will be received by the Board of Public Service, Lima, Ohio, until Dec. 21, for furnishing machinery, material and labor required in connection with the construction of an electric light plant. Specifications call for water-tube boilers, breeching and stack, steam and electric prime movers, steam plant auxiliaries, exhaust and water piping valves and fittings; lighting equipment, pole line construction, erection of wires, etc. Plans and specifications can be seen at the office of the Board of Public Service and at the office of C. E. F. Ahlm, 614 Caxton Building, Cleveland, Ohio. L. L. Crumrine is secretary.

SOUTH CHARLESTON, OHIO.—The County Commissioners have granted the Washington Traction Company a franchise to construct and operate its railway in this county.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company has been granted a 25-year franchise to operate in this city. This will enable the company to proceed with a number of contemplated improvements, and in addition the officers expect to secure a 10-year contract for street lighting. This is the company that some time ago took over the other two companies operating in Springfield.

VERMILLION, OHIO.—F. W. Coen, general manager of the Lake Shore Electric Railway Company, of Cleveland, Ohio, has been granted a franchise to furnish electricity in the village of Vermillion; also a contract for street lighting. Thirty arc lamps will be installed.

YOUNGSTOWN, OHIO.—The Lake Erie & Youngstown Railway Company has applied to the City Council for a franchise to enter the city with its proposed electric railway from Conneaut to Youngstown, Ohio. John H. Ruhlman is reported to be interested in the enterprise.

AFTON, OKLA.—Plans are being made to develop the water power of Grand River to generate electricity for distribution in Afton and several other towns in this part of the State. A site has been selected about 10 miles above Afton, where a dam will be built. It is stated that surveys and estimates of the water power of the Grand River have been made by Captain J. Odell, of Joplin, Mo., for the Joplin Light & Power Company, of Joplin, Mo.

AFTON, OKLA.—Contracts have been awarded for power equipmest for the water works plant at Afton, Okla., as follows: For engines, to the English Iron Company, Kansas City, Mo.; tower and tank, to the Chicago Bridge & Iron Company, of Chicago, Ill.; generator, exciter and switchboard, to the Westinghouse Electric & Manufacturing Company, Kansas City, Mo.; motor pump, to Reeves & Skinner, St. Louis, Mo.; steam specialties, to the English Iron Company, Kansas City, Mo., and boilers, to the Kansas City Engineering Company, Kansas City, Mo. The W. K. Palmer Company, Dwight Building, Kansas City, Mo., has charge of the engineering work.

COLLINSVILLE, OKLA.—The City Council is reported to be considering the question of granting an electric lighting franchise.

MARLOW, OKLA.—Plans are being considered for improvements to the municipal electric light plant and water works system, the cost of which is estimated at $10,000.

RYAN, OKLA.—An election will soon be held to vote on the proposition to issue bonds for the construction of a municipal electric light plant.

ROSEBURG, ORE.—It is reported that the Alameda Consolidated Mines Company is making arrangements for the development of a water power of from 6000 to 8000 hp, and also to construct an electric railway to some convenient point on the Southern Pacific Railroad.

THE DALLES, ORE.—The City Council is reported to be considering the question of installing a municipal electric light plant. The city owns considerable water power on Mill Creek, which may be developed to generate electricity to light the city.

BELLEFONTE, PA.—The Borough Council has purchased the old Green property at Milesburg, including water power. It is proposed to erect a hydro-electric plant to generate electricity to operate a municipal electric light and power plant.

ELK CITY, PA.—The Pennsylvania & Maryland Street Railway Company has filed a mortgage in favor of the Farmers' Loan & Trust Company, of New York, N. Y., as trustee to secure an issue of $1,000,000 in bonds.

JOHNSTOWN, PA.—The City Council has awarded the contract for furnishing electricity for lighting the city for 10 years to the Citizens' Light, Heat & Power Company, of Johnstown. The company will furnish arc lamps at the rate of $50 per lamp per year and incandescent lamps of 70 cp at $25 each per year, beginning Jan. 1, 1909.

McKEES ROCKS, PA.—It is stated that the local plant of the Pressed Steel Car Company is to be operated by electricity. The new power house of the company is nearly completed.

PENNSBURG, PA.—Application has been made to the Borough Council by J. L. Bowles, of New York, N. Y., for a franchise to operate an electric railway through the borough. Similar applications have been made to various towns in the Perkiomen Valley through which the railway will pass.

PITTSBURG, PA.—Application has been made for a charter for the Scott Township Street Railway Company by W. E. Kusen, A. J. Schmidt, C. August Stuetz, W. P. Heckman and J. D. C. Miller, of Pittsburg. The company proposes to build a street railway from Scott Township to a point on the Castle Shannon Road.

PITTSBURG, PA.—Estimates have been submitted by Reiter, Curtis & Hill, the H. S. Kerbaugh Construction Company and Charles Simms for work along the main line of the Pennsylvania Railroad involving an expenditure of about $5,000,000. The work includes the construction of

a dam on the Juniata River and the erection of a large power plant near Lewistown.

WARREN, PA.—Bids will be received until Dec. 18 by the building committee of the Board of Trustees of the State Hospital for the Insane at Warren, Pa., for furnishing and installing two natural gas engines, electric generators and switchboards in the electric light and power plant. S. W. Waters is secretary of the board and J. W. Greenland, steward.

CHESTER, S. C.—The Southern Power Company has acquired all the necessary rights of way for the completion of its transmission line into Chester, and work is progressing rapidly on the completion of the line. The company, which already owns valuable rights in Chester County, has secured water rights and options along Fishing Creek and Catawba River, and is contemplating the construction of a third plant in the near future. It is said that about 20,000 hp will be developed. It is expected that the Rocky Creek plant will be completed about March 1.

LEXINGTON, S. C.—Plans are being made to erect telephone lines throughout the county. A system has recently been installed at Gilbert and the telephone lines are being extended on both sides of the railroad. It is said that the telephone lines will be extended from Gilbert to Pelion, a distance of about 16 miles.

WESTMINSTER, S. C.—The Traxler-Taylor Real Estate Company, of Greenville, S. C., is reported to have secured two tracts of land near Westminster, and proposes to organize a company, with a capital stock of about $100,000, to improve and develop the property. It will install an electric plant to furnish electricity for lamps and motors.

ABERDEEN, S. D.—The City Council has decided to adopt a new street lighting system at a cost of $150 per month.

HURON, S. D.—F. H. Kent and associates have applied for a franchise to erect a telephone exchange in Huron.

FLORESVILLE, TEX.—T. J. Largen and Douglas Largen, of San Antonio, Tex., who were recently granted a franchise to erect an electric light plant in Floresville, it is said, will soon commence work on construction of the plant.

LEONARD, TEX.—The plant of the Leonard Electric Company was damaged by fire recently.

SAN AUGUSTINE, TEX.—It is reported that plans are being considered to establish an electric light plant in San Augustine. Mr. Nance, of Conroe, Tex., is said to be interested in the project.

SWEETWATER, TEX.—The Sweetwater Light, Ice & Water Company is installing a water works system, for which contracts for equipment of plant have been awarded. Orders for ice plant equipment will be placed in the near future. The company proposes to issue bonds to the amount of $70,000, the proceeds to be used for the installation of an electric light plant and extension of the water works system. The property of the old municipal company was turned over to the new company free of charge. A. H. Place, of Kansas City, Mo., is consulting engineer.

SALT LAKE CITY, UTAH.—Notice of appropriation of 2000 cu. ft. of water from the Green River in Emery County has been filed by the Grand Canyon Power Company. The company proposes to construct a large dam in the Green River 200 ft. below its junction with Coal Creek. The present plans call for the development of about 38,000 hp.

BOLTONVILLE, VT.—The equipment of the electric plant of the Ryegate Light & Power Company at Boltonville, Vt., will include twin water turbines with cylinder gates, made by the S. Morgan Smith Company, of York, Pa., which will develop 330 hp; one 240-kw Westinghouse, three-phase, 60-cycle, 6600-volt generator direct connected to waterwheel shaft. Exciter, switchboard and lightning-arrester equipment will be furnished by the Westinghouse Electric & Manufacturing Company. Orman B. Humphrey, 96½ Exchange Street, Bangor, Maine, is consulting engineer.

BUENA VISTA, VA.—The Rockbridge Power Company has perfected organization and the following-named officers elected: W. G. Mathews, president; P. M. Penick, vice-president; W. T. Paxton, secretary and treasurer, all of Buena Vista, Va.; John L. Livers, of Lancaster, Pa., general manager and engineer. The company has purchased Gooseneck Dam, near Lancaster, Pa., and proposes to develop 1000 hp, to be transmitted by electricity to Buena Vista.

FORT MONROE, VA.—Bids will be received by Captain Ernest R. Tilton, constructing quartermaster, until Jan. 4, 1909, for furnishing and installing two 264-hp and 100-hp boilers, one 250-hp and one 120-hp engines, two 150-kw and one 75-kw generators; also all exhaust steam drip and water suction and discharge connections, one service condenser and gage board, two boiler feed pumps, three composite inspirators, one feed-water heater, one hot well pump for oil separator; also for furnishing and installing complete underground system and complete system for street lighting at Fort Monroe, Va. Bids for the five different kinds of work must be submitted separately. Information furnished on application to Captain Ernest R. Tilton, constructing quartermaster.

SOUTH BOSTON, VA.—The Century Knitting Mills, recently incorporated, is planning to install machinery, the initial equipment to cost $25,000. The mill will be operated by electricity. F. A. Lukin is president.

BELLINGHAM, WASH.—It is reported that the Stone & Webster interests contemplate doubling the output of the Noosack power plant to supply electricity to operate the proposed Skagit interurban railway.

SEATTLE, WASH.—Application has been made to the City Council by the Seattle, Renton & Southern Railway Company for a franchise for extension of its system on several streets in the city.

TACOMA, WASH.—The Pacific Traction Company has completed plans and specifications for the construction of several extensions in Tacoma, for which franchises have been granted by the City Council. T. G. Seixas, of Tacoma, is vice-president and general manager.

WALLA WALLA, WASH.—Plans are being considered for the construction of a railway from Dayton to the Columbia River. It is proposed to take over the franchises and rights of way and other property of the old company organized two years ago, under the name of the Walla Walla-Columbia Traction Company. Dr. N. G. Blalock is general manager.

CHARLESTON, W. VA.—Contracts have been awarded for the construction of a new independent telephone line from Parkersburg to Athens and Pomeroy, where connections will be made with the independent lines out of Columbus, at a cost of $40,000.

HINTON, W. VA.—The Hinton Water, Light & Supply Company contemplates abolishing the flat rate service and the installing of meters, and also the installation of a day service after Jan. 1, 1909. H. Ewart is secretary and manager.

MARTINSBURG, W. VA.—The Berkeley Traction Company has been granted a franchise by the Common Council to construct and operate an electric railway in Martinsburg. It is said that the company will expend $750,000 in this city. Plans are being formed by the company to construct a railway from Martinsburg to Shepherdstown, Charlestown and Winchester, 60 miles in length.

MARINETTE, WIS.—The Northern Hydro Company will construct a hydro-electric plant on the Peshtigo River at High Falls about 15 miles from Crivitz. About 5000 hp will be developed at a cost of about $2,000,000. Work on construction of the plant will begin next spring.

NORTHFIELD, WIS.—The Northfield Farmers' Telephone Company has increased its capital stock from $7,000 to $14,000.

CALGARY, ALB., CAN.—A company is being organized here to build an electric railway from this city to Millarville, 28 miles distant. For further information address E. L. Richardson.

EDMONTON, ALB., CAN.—According to a report made by the city electrician, the municipal electric plant is unable to meet the demands made upon it. The city Council is considering plans to increase the output of the plant. For further information address City Commissioner McNaughton.

CRANBROOK, B. C., CAN.—Kootenay Telephones, Ltd., a newly incorporated concern, will build a telephone line along the route of the new railway from McGillvray to Corbin. In addition, the new country on the Canadian side of the boundary, north of Spokane, will be served by the company's lines.

REVELSTOKE, B. C., CAN.—The Bull River Light & Power Company is preparing to install a flume during the present winter. C. E. Henderson is president and general manager.

SYDNEY, N. S., CAN.—John Preston, mechanical engineer of the Nova Scotia Steel & Coal Company, it is stated, has reported in favor of installing a turbo-generator set at Sydney Mines. The Dominion Iron & Steel Company, Ltd., contemplates installing a turbine plant in the spring.

BERLIN, ONT., CAN.—The Algoma Power Company is planning to install another 300-kw unit in its plant at Michipicoten Falls, Ont., when the present extensions are completed. C. H. Mitchell, Traders' Bank Building, Toronto, Ont., Can., is consulting engineer.

BRANTFORD, ONT., CAN.—The aldermanic and general citizens power committee has voted to recommend to the City Council to enter into a contract with the Hydro-Electric Commission for electricity for light and power. It is understood that the Cataract Power Company will submit another proposition to the Council in the near future.

BRIDGEBURG, ONT.—The Board of Trade has decided to ask the Village Council to submit to a vote in January the proposition to erect a municipal electric light plant. The Canadian Power Company has submitted a proposition to furnish 60 arc lamps at $57.50 per lamp per year. This is considered too high, and the executive committee has instructed Mr. Robinson, the electrical engineer employed by the village, to prepare an estimate of the cost of lighting the streets with improved incandescent lamps.

FORT WILLIAM, ONT., CAN.—At the coming municipal elections the ratepayers will vote on a by-law to provide $18,000 for extensions to the municipal electric lighting system; also to provide $170,000 for improvements to that portion of the Port Arthur municipal street railway system running in that city.

MERRITON, ONT., CAN.—The contract for a transformer for reducing the voltage from 2200 to 110 and for wire, gooseneck posts and all other fixtures for a complete incandescent street lighting system has been let to the Robertson Electric Company, of Buffalo, N. Y.

PORT ARTHUR, ONT., CAN.—Philip Labbe, of Labbe, Garvis & Co., Minneapolis, Minn., has made an offer of $700,000 cash for a 20-year franchise of the municipal street railway operating here and in the sister city of Fort William.

TORONTO, ONT., CAN.—It is reported that the Toronto Power Company, which took over the Electrical Development Company last spring, will acquire the property of the Toronto Electric Light Company by exchanging five Toronto Power debentures for four of Electric Light, which is equivalent to paying 125 for Electric Light stock.

New Industrial Companies.

THE RACINE ELECTRICAL MANUFACTURING COMPANY, of Racine, Wis., has been incorporated, with a capital stock of $25,000, by Charles A. Kroynik, Charles M. Deitrich and Albert E. Anderson.

THE ELECTRO-AUTOMATIC DISPLAY COMPANY, of Dover, Del., has been incorporated, with a capital stock of $1,000,000, by Robert C. Morris, George T. Woods, Edward R. Drake and Harry L. Means, of Louisville, Ky.

THE PIERSON MOTOR SUPPLY COMPANY, of New York, N. Y., has been chartered, with a capital stock of $20,000, to manufacture motors, engines, machines, etc., by F. W. Mills, H. M. Browne, E. J. Forhan, all of New York, N. Y.

THE GRENAGLE ELECTRIC COMPANY, of Baltimore, Md., has been incorporated, with a capital stock of $50,000, by Howard Claude Lewis, Morrill N. Packard and others. The company proposes to manufacture electric lamps.

THE STRANG ELECTRIC COMPANY, of Camden, N. J., has been incorporated, with a capital stock of $25,000, to manufacture electrical appliances, etc. The incorporators are E. P. Strang, W. B. Strang and L. M. Strang, all of Camden, N. J.

THE HARDT ELECTRIC COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $50,000, to manufacture electrical appliances. The incorporators are Roswell M. Patterson, George Link, Jr., and Charles Rush, all of New York, N. Y.

THE HUNTER ELECTRIC COMPANY, of New York, N. Y, has been chartered, with a capital stock of $10,000, to manufacture machinery, electrical and mechanical appliances. The incorporators are George J. Constable, Andrew Greenfield and Louis Segee, all of Brooklyn.

THE PEMIGEWASSET ELECTRIC COMPANY, of Portland, Maine, has been incorporated, with a capital stock of $150,000. The officers of the company are: A. G. McPhierson, president; J. R. Parsons, treasurer, and W. M. B. Bradly, all of Portland, Maine. The company proposes to do general merchandizing.

THE BUTLER ELECTRIC CLUTCH COMPANY, of Yonkers, N. Y., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of manufacturing electric clutches. The incorporators are William W. Butler and Martin E. Thew, of Yonkers, N. Y., and Clarence Alexander, of New York, N. Y.

THE RADU SURGICAL INSTRUMENT COMPANY, of North Tonawanda, N. Y., has been chartered to manufacture surgical, electrical and scientific instruments and appliances. The incorporators are William Allen and James P. Mackenzie, of North Tonawanda, N. Y., and George W. Morris, of Buffalo, N. Y.

THE IMPROVED APPARATUS COMPANY, of New York, N. Y., has been chartered, with a capital stock of $40,000, to manufacture and deal in mechanical and electrical devices and equipment. The incorporators are George Williams, of New York, N. Y.; Carle B. Gilbert and Louis F. Musil, of Brooklyn, N. Y.

THE SAMUEL H. PITCHER COMPANY, of Worcester, Mass., has been chartered, with a capital stock of $6,000, to conduct a general civil engineering and construction business. The officers of the company are: Samuel H. Pitcher, president; Frederick H. Clark, treasurer, and William J. Woods, clerk, all of Worcester, Mass.

THE OSBORNE REA & COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $10,000, for the purpose of manufacturing engines, machinery, elevators, heating and ventilating machinery, etc. The incorporators are Charles T. Osborne, of New York, N. Y., and Daniel R. Rea, of Elmhurst, N. Y.

THE LONG ISLAND ENGINEERING & CONTRACTING COMPANY, of Queens, N. Y., has been incorporated, with a capital stock of $5,000, by Gerald A. Hickery, of Laurel Hill, N. Y.; Leon M. Schoonmaker and Robert D. Eggleston, both of New York, N. Y. The company proposes to do a general contracting business.

THE NATIONAL ELECTRIC MANUFACTURING COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $50,000, for the purpose of manufacturing and selling electrical apparatus. The officers of the company are: Starbuck Sprague, president; Charles H. Sprague, treasurer and clerk, both of Boston, Mass.

THE UNITED STATES LIGHT & HEATING COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $10,000, to manufacture lamps, machinery and appliances for light and heat. The incorporators are John L. Linehan and John Miller, of New York, N. Y., and Frederick Holman, of College Point.

THE HART & WIDDER COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $15,000, by Charles N. Hart, of East Orange, N. J.; Stanley W. Hart, of New York, N. Y., and Charles A. Widder, of New York, N. Y. The company proposes to act as machinists, mechanical, electrical and civil engineers, steamfitters, etc.

THE INTERNATIONAL ENGINEERING COMPANY OF NEW JERSEY, of Jersey City, N. J., has been incorporated, with a capital stock of $10,000, for the purpose of manufacturing engines, machinery, motors, vehicles, etc. The incorporators are Leland B. Garretson, J. Cotter Connell and Alexander S. Campbell, of Jersey City, N. J.

THE JAEGER TUNGSTEN LAMP COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $30,000, to manufacture tungsten lamps, electrical and illuminating appliances. The incorporators are: William C. Lilieholm, of Brooklyn, N. Y.; Cornelius S. Pinkney, Harry J. Robinson, Jerome Wilzin, all of New York, N. Y.

THE STORAGE BATTERY COMPANY, of St. Louis, Mo., has been incorporated, with a capital stock of $200,000, by William Gardiner, John Sterlin, George S. Tourville, Wm. G. Evers, Edward M. Cooper and Oscar A. Morgner. The battery is an invention of William Gardiner, of St. Louis. George S. Tourville, who will be president of the company and general distributing agent, says: "The plates in the battery are made with a secret formula, known only to Gardiner. They will last three years, whereas the ordinary plate lasts between 12 and 18 months." The company will have its headquarters at 2107 and 2109 Pine Street.

New Incorporations.

SACRAMENTO, CAL.—Articles of incorporation have been filed for the South Feather Land & Water Company by D. S. Wasserman, J. S. Gattmann, S. F. McNear, L. S. Hinsdale and L. G. Siller, all of Sacramento, Cal. The company is capitalized at $250,000 and proposes to acquire water rights for the sale and distribution of water for irrigation purposes and the development of water power and electrical plants in Butte, Plumas and Yuba Counties.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the San Diego & Imperial Beach Railway Company by G. Y. Gray, E. W. Peterson, R. B. Thomas and R. A. Smith. The capital stock of the company is $25,000.

SAN FRANCISCO, CAL.—The United States Electric Light & Power Company has been incorporated, with a capital stock of $40,000,000. It is reported that the company has been formed for a holding company to take over the stocks, bonds and mortgages of the Spring Valley Water Company.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Natoma Consolidated Companies of California, with a capital stock of $25,000,000. The purpose of the company is to work mines, dealing in dredges and vessels, constructing reservoirs, supplying water and electricity, and gas for light, heat and power. The incorporators are Frank W. Griffin, Charles W. Slack, Maurice E. Griffin and others, of San Francisco, Cal.; George R. Ray, Richmond Strong, of Oakland, Cal., and others. W. P. Hammon, of San Francisco, Cal., chief promoter of the project, will have general management of the company. The Feather River Development Company, the Natoma Development Company and the Folsom Development Company and several other companies have been taken into the consolidation.

COLORADO SPRINGS, COL.—The Grand Junction Electric Railway Company has been incorporated with a capital stock of $100,000 by Horace Devereaux, Eugene A. Sunderline, Thomas A. Curtis, Henry C. Hall and Frank Mahon. The company proposes to build an electric railway from Grand Junction to Palisade, Col., a distance of 17 miles.

DOVER, DEL.—Articles of incorporation have been filed for the Eastern States Telephone & Telegraph Company by Richard J. Morgan, Robert Voss Marye, both of New York, N. Y.; William S. James, of Brooklyn, N. Y.

WILMINGTON, DEL.—The Columbia Power, Light & Railways Company has been chartered to act as a holding company for the Columbia & Montour Electric Railway Company, the Danville & Bloomsburg Street Railway Company, the United Gas & Electric Company, the Irondale Electric Light Company, the Standard Electric Light Company, the Standard Gas Company and the Berwick Electric Light Company. The incorporators are: W. H. Sponsler, of New Bloomfield, Pa.; M. P. Reed, of Philadelphia, Pa., and C. L. Ward, of Wilmington, Del. The company is capitalized at $1,200,000.

VALDOSTA, GA.—The Valdosta, Moultrie & Western Railroad Company has been chartered with a capital stock of $100,000 by Frank Roberts, W. B. Conoley, John T. Roberts, W. L. Roberts, A. L. Davis, W. E. Davis, A. F. Langford, D. Ingram and J. L. Giddens, of Valdosta, Ga., and W. P. Roberts, of Jacksonville, Fla. The railway will be about 40 miles in length.

DE KALB, ILL.—Articles of incorporation have been filed for the De Kalb Midland Railway Company, with a capital stock of $150,000, by John W. McQueen, Herbert J. Burdick and William G. Wilcox, of Elgin, Ill.; O. Fred Cole and John F. Pearce, of Chicago, Ill. The company proposes to construct an interurban railway to connect De Kalb and Sandwich, Ill.

FREEPORT, ILL.—The Freeport Interurban Railway Company has been incorporated, with a capital stock of $2,500, to construct and operate a railway from Freeport to Dixon, Ill. The incorporators are: Owen T. Smith, W. A. Hance and F. A. Read.

McLEANSBORO, ILL.—The McLeansboro Independent Telephone Company has been incorporated with a capital stock of $2,500 by M. M. Stephenson, J. R. Cross and Matthew McMahon.

ELNORA, IND.—The Elnora Co-operative Telephone Company has filed articles of incorporation. Thomas M. Sears, J. E. Pershing and James W. Pruitt are directors.

DULUTH, MINN.—The National Light Company has been incorporated with a capital stock of $10,000 by Henry G. Gearhart, M. L. Cunningham and A. M. Johnson, of Duluth, Minn.

MACON, MO.—The citizens on Nov. 27 voted in favor of issuing $18,400 in bonds, the proceeds to be used to extend the municipal electric light plant and water works system. E. S. Bennett is superintendent.

NEOSHO, MO.—The Farmers' Union Telephone Company has been incorporated, with a capital stock of $1,750, by A. L. McConnell, J. B. Graves, George Hoover, W. T. Matthews and others.

CULBERTSON, MONT.—The Dakota Western Telephone Company has been incorporated with a capital stock of $200,000 by H. C. McCartney, T. F. Marshall, of Oakes, N. D.; J. J. DeLaney, of Streeter, N. D. The company proposes to erect a telephone line from Palmero, N. D., to Havre, Mont.

BERNE, N. Y.—The Berne Telephone Company has been chartered with a capital stock of $10,000 by Henry Berne, Luther D. Hungerford and Nathaniel D. Galup, of East Berne, N. Y.

BUFFALO, N. Y.—Articles of incorporation have been filed for the American Telephone Company, with a capital stock of $300,000. The directors are: Herman R. Pease, Luther Hatch, John J. Tisdale, Barnet W. Harris, Reginald F. Penton, John G. Herb and Oliver O. Butcher, all of Buffalo, N. Y.

HILLSDALE, N. Y.—Articles of incorporation have been filed for the Hillsdale Telephone Company with a capital stock of $5,000 by Frank R. Gilbert, Edward T. Logan and Jacob Pfeiffer, of Hillsdale, N. Y.

PORT JERVIS, N. Y.—The Port Jervis & Delaware Valley Railroad Company has been chartered with a capital stock of $200,000 to construct and operate an electric railway between Port Jervis and Milford, a distance of 7 miles.

VESTAL, N. Y.—The Vestal Light Company has incorporated with a capital stock of $1,000 to carry on a lighting business in Vestal, Union and Endicott. The directors are: Herbert D. Harris, William S. Pierce and others.

CARTHAGE, N. C.—The Co-operative Telephone Company has been incorporated with a capital stock of $25,000 by .J F. Cole, G. McLeod and C. F. Leavitt.

FAYETTEVILLE, N. C.—The Consolidated Railway & Power Company has been incorporated to construct and operate railways within a radius of 50 miles of Fayetteville. It is reported that the new company proposes to purchase the properties and holdings of the Fayetteville Street Railway & Power Company and the Little River Power & Transportation and to complete the railway through to Hope Mills. The incorporators are: W. D. McNeill, J. Sprunt Newton, Mrs. M. C. McArthur and Mrs. M. M. B. McRae, all of Fayetteville, N. C.; H. A. Haines and A. G. Bishop, of New York, N. Y.

PORTLAND, ORE.—The Clackamas Land & Electric Power Company has been incorporated with a capital stock of $500,000 by Wirt Minor, H. B. Crossman and C. K. Williams.

FORD CITY, PA.—The Ford City Power Company has been organized to furnish electricity for lamps, heat and motors for public and private interests.

MANORVILLE, PA.—Articles of incorporation have been filed for the Manor Light, Heat & Power Company, with a capital stock of $10,000.

SUNBURY, PA.—The Middle Creek Electric Company will soon commence work on the construction of a large power plant at Sunbury. The company now operates two plants, one on Middle Creek near Selinsgrove and one at Northumberland.

EL CAMPO, TEX.—The Water & Light Company has been incorporated, with a capital stock of $100,000, by G. S. Phelps, A. L. Strong and W. B. Blair.

BRATTLEBORO, VT.—The Brattleboro & Vernon Railroad Company has been incorporated with a capital stock of $10,000 to construct an electric railway from Brattleboro through Vernon to the Massachusetts line. The incorporators are: Charles R. Crosby, George L. Dunham, H. L. Emerson, J. H. Estey, Olin L. French, Lyman E. Holden, of Brattleboro; John Wright and T. E. Stockwell, of Vernon, Vt., and others.

NEW KENT, VA.—The New Kent Telephone & Telegraph Company has been chartered with a capital stock of $5,000 and the following officers: C. L. Harrison, of Talleysville, president; R. E. Richardson, of Talleysville, vice-president; T. N. Harris, of New Kent, secretary and treasurer.

SPOKANE, WASH.—Plans have been drawn by Albert Held, architect of the new Sacred Heart Hospital, for an electric plant to furnish electricity for lighting the building.

TACOMA, WASH.—The Mountain Lake Development Company has been incorporated with a capital stock of $200,000 by D. P. Simonds, Jr., of Seattle, Wash., and others. The company proposes to develop water power and construct and operate electric and power systems.

Legal.

TELEGRAPH COMPANY NOT LIABLE TO ADDRESSEE OF MESSAGE FOR ERRORS IN TRANSMISSION.—The New York Court of Appeals has handed down a decision under which a telegraph company cannot be held for damages by a person to whom a telegram is sent, for errors made by the company's employees in transmitting the message, where a provision on the back of the telegraph blank stated that the company would only be liable for mistakes in case the message was repeated. The plaintiff in the action, in which this determination was reached, had requested a manufacturer to wire him the price of certain material. A mistake was made in the transmission of the message and the telegram as received gave a lower figure than the manufacturer stated in his message. On the back of the telegraph blank was the usual provisions claiming an exemption from liability for errors or mistakes except in cases where the message was repeated. The message in this instance was not repeated and the plaintiff, acting upon the price stated in it, entered into contracts which he was subsequently compelled to carry out at a loss. The following is quoted from the opinion of the Court: "By reason of the franchises and powers accorded to it, a telegraph corporation performs public functions and it comes under that general obligation to which all quasi-public corporations are subject to conduct its corporate business, and to discharge the duties incident thereto with reasonable diligence and with a due care for the rights and interests of those concerned in the corporate operations. But, however strictly held to this general obligation, it is competent for it to make such rules and to prescribe such regulations for the conduct of its business as are reasonable. It is entitled to protect itself against the incident hazards of operation and, by contract, to limit its liability for mistakes, or delays, or non-delivery, caused by the negligence of its servants, if not gross." Halstead v. Postal Telegraph-Cable Co., New York Court of Appeals, Nov. 10, 1908.

AN ELECTRIC LIGHT STATION A "FACTORY" WITHIN THE MEANING OF A RESTRICTIVE BUILDING COVENANT.—An action was brought for the purpose of restraining an electric light company from maintaining its station on a plot of land which formed part of a tract known as the Monmouth Beach tract. The ground on which the injunction was asked was that the deed to the property contained a covenant to the effect that no factory should be erected or operated on the property. It was denied by the defendant company that an electric light station, with its usual equipment of machinery, was a factory within the meaning of the covenant and this was the question presented for the determination of the Court. The question was disposed of in the following words: "It is useless to go into speculative questions as to the nature of electricity or the nature of the product, if there be a product, of the electric plant which the defendant operated at the time of the filing of the bill. At different periods in the history of electrical discovery very different views have been entertained on this subject. At one time this plant might have been regarded as a manufactory of a 'fluid.' More recently it might be deemed to be turning out electrons or ions. All speculation is stopped, I think, by the recent decision of the Court of Errors and Appeals in the case of Bates Machine Co. v. Trenton & N. B. R. R. Co., and the cases cited in the opinion of the court delivered by Mr. Justice Garrison. This recent decision seems to me to answer the question in regard to the character of the defendant's plant, which has been argued in this case, in favor of the complainants. This electric light station, with the necessary incidents attending its operation, is in my judgment as clearly a manufactory, within the meaning of this protective covenant, as it is a manufactory within the meaning of the mechanic's lien law. If a distinction can be made in favor of the defendant in this case, I think that it should be left to the higher court to draw such distinction. It may be conceded that when this covenant was framed and the Monmouth Beach 'scheme' was promulgated, about 35 years ago, the 'manufacture' of electricity in electric light stations was unknown. In view of the annoyance and discomforts which it was the intention of the scheme to exclude from this large residential district, no distinction can be drawn between manufacturing businesses which were in existence when the scheme was promulgated, and manufacturing businesses which might thereafter come into existence." Scrymser v. Seabright Electric Light Co., Court of Chancery of New Jersey.

Educational.

MECHANICAL AND ELECTRICAL ENGINEERING AT NOTRE DAME.—The mechanical and electrical engineers, students of Notre Dame University, Notre Dame, Ind., have mapped out an interesting program for the year. It includes tours of inspection to the most important electrical plants in the nearby cities, besides a lecture course. Prominent engineers will be invited to lecture at meetings to be held every other week, at which students in the engineering classes will also discuss various phases of electricity and mechanics.

Personal.

MR. FIELDING YOST has been appointed general manager of the electric power plant at Great Falls, near McMinnville, Tenn.

MR. G. E. TRIPP, vice-president of Stone & Webster, Boston, has been retained as special advisor to the joint committee on reorganization of the Metropolitan Street Railway, New York.

MRS. DR. LEE DEFOREST, who is a graduate from the civil engineering course at Cornell, will, it is reported, equip and take charge of a factory in Newark for the manufacture of electric condensers.

MR. JOHN C. DOLPH has severed his connection with the Standard Varnish Works, but has not yet made any engagements for the future. His present address is Room H5, Produce Exchange, New York City.

MR. T. H. McCAULEY, who formerly was superintendent of the municipal street railway system at Port Arthur, Ontario, has been appointed superintendent of the electric light, power and telephone systems in that city.

MR. W. E. MOORE, consulting engineer of the West Penn Railways Company, Connellsville, Pa., has been appointed operating manager of the company, in which position he will succeed Mr. George R. Folds, resigned, who was general manager of the company.

MR. H. B. STABLER, of Washington, D. C., has just been appointed construction engineer for the Washington division of the Chesapeake & Potomac Telephone Company, succeeding Mr. G. K. Selden, who has become plant supervisor for the system of the Southern Bell Telephone & Telegraph Company.

MR. F. J. SOUTHERLAND has been appointed purchasing agent and assistant manager of the Monterey County Gas & Electric Company and Monterey & Pacific Grove Railway, Monterey, Cal., following a two-year period of reorganization of the generating and distributing departments of the companies.

MR. J. F. LAND, formerly with the Michigan Telephone Company, has begun the manufacture of a device which will answer the calls of telephones when the person called is out. It will repeat twice to each call of the telephone any message the person expecting to be called desires to impart to it. Mr. Land has incorporated his company as the American Annunciaphone Company.

MR. FRANK J. DUFFY, formerly manager of the Beaumont (Tex.) Traction Company, has been appointed general manager of the company and general manager of the Jennings Electric Light & Power Company, Jennings, La., and the Southern Railway & Light Company, Natchez, Miss., all controlled by the same interests. Mr. Duffy has been associated with the Beaumont Traction Company for the past six years as secretary-treasurer and as manager. He will reside at Natchez.

MR. NORMAN McD. CRAWFORD has been elected president of the Mahoning & Shenango Railway & Light Company, Sharon, Pa., to succeed Mr. E. N. Sanderson, and has entered upon the duties of his new office. Mr. Crawford was formerly vice-president of the Ohio Electric Railway, which controls 790 miles of street and interurban electric railways in Ohio and operates a number of electric light and power companies. At one time he was general manager of the Hartford (Conn.) Street Railway and was a resident of Hartford for 15 years. As a contractor he built the Glastonbury line of the Hartford Street Railway in 1891, and was afterward retained by the company as engineer. In 1894 he was made general manager of the company, remaining until the Hartford Street Railway was taken over by the Consolidated Railway Company of Connecticut. The Mahoning & Shenango Railway & Light Company owns and controls street railways in Youngstown, Warren, Niles and other cities in Ohio, and Newcastle, Sharon, Wheatland, Sharpsville in Pennsylvania, and the lighting properties in Youngstown, Newcastle, Sharon and Sharpsville. In 1906 Mr. Crawford spent six months in Europe for the committee on public ownership and operation of the National Civic Federation, whose report is well known to our readers.

MR. JESSE M. SMITH, the president-elect of the American Society of Mechanical Engineers, was born at Newark, Ohio, in 1848, attended the Rensselaer Polytechnic Institute from 1865 to 1868 and studied also at the Ecole Centrale des Arts et Manufactures, Paris, for three years, taking the degree of mechanical engineer in 1872. He then visited various manufacturing plants in France, Belgium and Germany and attended lectures at the Polytechnic Institute in Berlin. He also visited iron and machinery works in England and began active practice in 1873 in blast furnace work in the Hocking Valley, Ohio. This involved surveys, smelting, coal handling and railroad construction. When his father died at Detroit in 1880 he returned to that city and established himself as a consulting engineer. In 1883 he designed and built a high-speed center-crank engine with shaft governor, embodying the idea of the modern inertia weight governor, and put it in operation with a Brush arc machine of 40 lights, thus beginning an intimate acquaintance with electrical development. He next represented the old United States Electric Lighting Company in Ohio and Michigan from 1884 to 1886, building many isolated plants, including that for the Stillman Hotel, Cleveland, said to be the first hotel lighted exclusively and continuously by electricity. In 1886 he resumed consulting work, and designed various plants for electric lighting and traction as well as apparatus for exhaust steam heating. He had already been in demand as an expert in patent litigation and this work grew to such an extent that in 1898 he moved from Detroit to New York, since when he has been connected with a number of important cases, including some on induction motors and incandescent lamps. Mr. Smith became a member of the American Society of Mechanical Engineers in 1883, served as a member of council, and has twice been vice-president. He is also a member of the American Institute of Electrical Engineers, the Société des Ingenieurs Civils de France; the Alumni Association of the Ecole Centrale; Detroit Engineering Society; American Association for the Advancement of Science; the American Geographical Society; the Ohio Society of New York, and the Engineers' Club.

JESSE M. SMITH.

Obituary.

MR. F. H. LEONARD.—It is with much regret that we record the death, last week, in New York City of Mr. F. H. Leonard, one of the earliest of the workers in the American field of arc lighting, particularly in New York State. He was connected with the old Thomson-Houston Electric Company for several years, up to the consolidation into the General Electric Company, and erected plants in no fewer than 22 towns and cities in this State; one of the first installations, probably the first Thomson-Houston plant in New York, being at Utica, where a large central station system is now the outcome. He organized several local companies and was actively successful in securing municipal and commercial contracts for them. He then went into the manufacture of electrical supplies, building up a large trade, and furnishing considerable equipment for the Chicago World's Fair of 1893. He next joined the firm of T. Pringle & Son, the hydraulic and mill engineers, and had much to do with the design and equipment of the plants at Shawinigan Falls, Lachine Rapids and the Cornwall Canal—the latter being a specially novel equipment at 11,000 volts, with 11 miles of bank lighting and electric lock gates. He was general manager of the Canadian Bullock Company until its merger with the Allis-Chalmers Company, and more recently he was connected with the Power & Mining Machinery Company. He was a member of the Canadian Society of Civil Engineers and took a keen and intelligent interest in all mechanical development, being not a little proud of his share in pioneer electrical advances. He was also a charter member of the Electrical Club of Montreal, and a member of the Canadian Electrical Association and the New York Electrical Society. He attended also in various capacities a great many conventions of the National Electric Light Association. He was only 48 years of age.

F. H. LEONARD.

Trade Publications.

SAMSON CORDAGE WORKS, Boston, Mass., are out early with a very handy and useful desk calendar pad for 1909 in black and red.

CRUSHERS for rock, coal and coke are fully illustrated and described in catalog No. 11 of the Pennsylvania Crusher Company, Philadelphia, Pa.

LIGHTNING ARRESTERS for telephone and telegraph lines are listed, illustrated and described in a booklet issued by the Minnesota Electric Company, Minneapolis, Minn.

STAR FORGE COMPANY, Buffalo, N. Y., have issued a very neat illustrated catalogue as to their forges, blowers, drills, blacksmith tools, etc., all of which are treated in great detail.

ELECTRIC NOVELTIES especially suitable for the Christmas season are illustrated, described and listed in Catalog No. 19 of the Knapp Electric & Novelty Company, 511 West 51st St., New York, N. Y.

WIRE REEL AND METER.—The Minneapolis Electric & Construction Company, Minneapolis, Minn., has issued an illustrated folder devoted to a wire reel and meter for reeling and measuring wire and cordage of various sizes.

PETTINGELL-ANDREWS CO., 156 Pearl Street, Boston, Mass., has issued a tasteful booklet on reading lamps, which are illustrated with brief description, in most tempting array. Copies will be sent free to any address on request.

TIME SWITCHES of the automatic type, designed for closing and opening circuits at desired times, are fully illustrated and described in bulletin No. 22 of the Albert & J. M. Anderson Manufacturing Company, Boston, Mass.

MICA.—The Carnegie Library, Pittsburg, has issued a pamphlet on "Mica," containing a large number of references to that substance in books, magazine articles, etc. It includes everything of value on the subject in the library up to Oct. 1, 1908.

NERNST LAMPS.—The Nernst Lamp Company, Pittsburg, Pa., has issued a witty miniature magazine, entitled "Lux," the pages of which cannot fail to be read by all into whose hands it may fall. Incidentally the magazine draws attention to the Westinghouse Nernst lamp.

RHEOSTATS.—The Union Electric Company, Milwaukee, Wis., has issued a fully illustrated descriptive catalog and price-list dealing with

rheostats for use in the armature and field circuits of direct-current motors and the field circuits of direct-current and alternating-current generators.

MACHINE TOOLS.—The Pratt & Whitney Company, Hartford, Conn., has issued a well-prepared, neatly illustrated catalogue devoted to milling machines, die sinkers and profilers. The machines are precision tools, especially adapted for the high-grade milling that is required in producing accurate work.

BLOWERS.—The B. F. Sturtevant Company, Hyde Park, Mass., in Bulletin No. 158, entitled "Our New Products," deals with commercial fans and blowers of various types, driven by its own electric motors, steam engines or steam turbines. These are applied to various purposes are most admirably described and illustrated.

STORAGE BATTERIES for use with remote-control oil switches are dealt with in bulletin No. 110 of the Electric Storage Battery Company, Philadelphia, Pa. Bulletin No. 111 is devoted to an automatic device for changing the average load on generators with sustained changes in the demand for use in connection with storage batteries.

VENTILATING APPARATUS.—The I. L. G. Electric Ventilating Company, Chicago, Ill., has issued the second edition of "Modern Ventilating Apparatus." This edition contains some valuable information regarding the ventilation of offices and public buildings, and in addition gives tables, prices and capacities of fans and blowers.

STONE & WEBSTER.—On some quarto cards of artistic design the Stone & Webster Engineering Corporation, Boston, Mass., furnishes some interesting details as to its organization, its building, the work done by it, etc. One card gives data and views as to the enlargement effected at considerable speed of the power plants of the Boston Elevated Railway.

INTERCOMMUNICATING TELEPHONES of the key-type are illustrated and described in Circulars Nos. 165 and 166, recently issued by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. This company has also issued mailing cards upon which interested persons may ask for specific information concerning intercommunicating telephones.

CONDULET AND BOX RECEPTACLES.—The Central Electric Company, of Chicago, has issued several new flyers on "Condulet" and box receptacles to fit the various makes of boxes now on the market. In the new design it is claimed that the volume of breakage is minimized, and furthermore that the contacts are of such capacity as to withstand extremely heavy overloads.

CHICAGO ELECTRICAL SHOW.—The Electrical Trades Exposition Company, Chicago, Ill., is sending out letter pasters in advertisement of the fourth annual electrical show which is to be held at the Coliseum, Chicago, Ill., Jan. 16-30. The pasters are designed to be used on letter heads. They contain the inscription, "See Our Exhibit, Electrical Show, Chicago, Jan. 16-30, '09."

DIRECT-CURRENT MACHINES, including generators and motors rated at from 6.035 kw to 15.0 kw, are listed and described in bulletin No. 39 of the Eck Dynamo & Motor Company, Belleville, N. J. In addition to giving data relating to the above-mentioned machines, the bulletin contains information concerning the selection and installation of generators, especially for lighting purposes.

CHRISTMAS TREE OUTFITS.—The Metropolitan Electrical Supply Company, Chicago, Ill., is sending out a circular calling attention to the Christmas tree outfits which it can supply in four different styles. These outfits consist of 12 ft. of double silk-covered cord, a connecting block, a connecting plug and a number of vari-colored electric light bulbs. They are designed to be used in lighting up Christmas trees.

IGNITION BATTERIES.—The Central Electric Company, of Chicago, is distributing a circular on "Combat" ignition batteries for automobile and gas engine service. The circular not only contains full description of the battery construction, but also gives directions for charging from the regular lighting circuits. Claims are made that corrosion at the binding posts is made absolutely impossible by special arrangement of the terminals.

GENERATING SETS.—Bulletin No. 109 of the Crocker-Wheeler Company, Ampere, N. J., describes small generating sets consisting of Crocker-Wheeler generators and engines made by the U. S. Rapid-Fire Gun & Power Company. These sets range from 2 to 19 kw, and are used to advantage for complete lighting plants for small hotels, apartment houses, etc. The design of the generators is described in Crocker-Wheeler Bulletin No. 100.

ELECTRIC FLATIRON.—The W. N. Durant Company, of 317 Milwaukee Street, Milwaukee, Wis., has issued a circular descriptive of the Watson electric flatiron. A special feature of this iron is that it contains simply a magnetizing coil, the entire body of the iron being the heating unit; it is claimed that this enables the work to be done with 40 per cent less current than with the ordinary resistance flatiron. The iron, of course, is used only on alternating-current circuits.

ALTERNATING-CURRENT GENERATORS.—General information, with formulas for calculating the amperes per phase, size of generator and engine required, and explaining the importance of considering the power factor when buying alternating-current apparatus, are given in Bulletin No. 108, just issued by the Crocker-Wheeler Company, of Ampere, N. J. The design of engine-type, alternating-current generators for central stations and industrial plants is fully described.

F. H. LOVELL & COMPANY, Arlington, N. J., have just issued an excellent catalog of U. S. Navy standard lighting fixtures and wiring appliances. It is divided into three sections—electric fixtures, wiring appliances and oil fixtures. With regard to the electrical apparatus, the serviceable plan is followed of giving outline dimensional drawings, so that the space required, etc., is at once seen. The devices and accessories here included are numerous and all appear to be admirably adapted to their purpose.

DIRECT-CURRENT GENERATORS.—General information and formulas for calculating the voltage drop in any direct-current feeder, the size of generator and engine required for lighting and power plants and a table of resistance and carrying capacity of wires are given in Bulletin No. 107, recently issued by the Crocker-Wheeler Company, of Ampere, N. J. The bulletin fully describes direct-current generators of large sizes, and contains a large number of illustrations showing complete installations.

AUTOMOBILE ACCESSORIES.—The General Electric Company has just issued a bulletin devoted to the description of automobile accessories manufactured by that company which will be of interest to automobile owners. The apparatus briefly described and illustrated in this publication consists of charging panels of various types, automobile instruments, automobile incandescent lamps, motor-generator sets, automobile motors and controllers, battery-charging rheostats, low-tension magnetos, air compressor outfits, etc. Bulletin No. 4629 describes these accessories.

SINGLE-PHASE TRANSFORMERS.—The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has issued circular No. 1157 giving a good technical description of its type S distributing transformer recently placed on the market. This transformer is provided with a cross-shaped, multi-circuit core for which many advantages are claimed. The coils are so formed that they can be individually insulated, the high tension being separated from the low tension by layers of paper and mica which afford permanent strong insulation. The details of the transformer are well described and illustrated.

CENTRAL STATION LOAD.—The Western Electric Company has recently been doing some very striking and effective advertising of lamps, motors, etc., in the leading magazines, newspapers and other journals, having, all told, a circulation of over 5,000,000 copies per issue. It is needless to say that such advertising must have and is having a perceptible effect in increasing the central station load. A number of these advertisements have been brought together by the company in an attractive pamphlet, showing clearly the nature of this "educational" propaganda.

HOLIDAY GOODS—LAMP GUARDS.—The Central Electric Company, Chicago, is distributing a new line of circulars devoted to articles intended for holiday gifts such as electric-heating devices, Christmas-tree outfits, electric curling irons, etc. Copy of these circulars will be sent upon request. It is also sending out a new folder describing the "Never Break" electric lamp guards and approved electric fittings. The circular embodies some 40 pages and contains interesting information taken from the reports of the Electrical Bureau and National Board of Fire Underwriters.

DIRECT-CURRENT PORTABLE INSTRUMENTS.—Bulletin No. 4630, recently issued by the General Electric Company, Schenectady, N. Y., contains a description of the company's direct-current portable instruments Type DP, designed for laboratory and general testing purposes. These instruments are so constructed as to be easily portable and are well protected from mechanical injury and from the effect of stray fields. The scales are very legible and the indications of the pointer are rendered perfectly dead-beat. This line of instruments comprises ammeters, voltmeters, mil-ammeters and milli-voltmeters. A full description, together with prices, will be found in the bulletin.

ST. CLAIR TUNNEL.—The electrification of the St. Clair or Sarnia tunnel of the Grand Trunk Railway is exciting considerable attention and was illustrated and described in the ELECTRICAL WORLD last week. The equipment was furnished by the Westinghouse Electric & Manufacturing Company, of Pittsburg, which has now issued a tasteful brochure on the subject, giving details of the work. The equipment is single phase and the pamphlet gives a full and interesting list of the roads of this character in America and Europe, grouped under the names of the respective manufacturers. The installation is another instance of the trend of the practice of the great main lines of railroad toward electricity.

FILTERS AND EXTRACTORS.—The Blackburn-Smith feed-water filter and grease extractor has been chosen for the new colliers, *Mars*, *Hector* and *Vulcan*, now being built for the U. S. Navy by the Maryland Steel Company. The filters are to be placed in the feed lines, so that every drop of water entering the boilers is subjected to the double filtration, characteristic of the Blackburn-Smith filter. It is figured that by removing the oil and grease particles from the condensation, the filters will repay their cost in a short time by decreasing boiler repairs and increasing fuel economy. These filters are made by James Beggs & Co., 109 Liberty Street, New York, who are distributing an interesting booklet on feed-water filtration.

ELECTROLYTIC RECTIFIERS.—The American Battery Company, Chicago, Ill., is sending out a booklet descriptive of the American electrolytic rectifiers. The booklet contains 16 pages of matter, a part of which is devoted to the design, application and maintenance of the rectifier. One page calls attention to the fact that the American rectifiers are made in a number of sizes and styles designed to meet the demand for a low-priced device for making use of an alternating-current supply for the charging of storage batteries of from 1 to 50 cells of any capacity up to 300 amp hours. It is also stated that it may be profitably used in the charging of storage bat-

teries of the ignition type for electric vehicles, storage batteries for dentists, and physicians' use, for telephone, telegraph, signal work and many other applications.

WARD LEONARD CIRCUIT-BREAKERS.—The Ward Leonard Electric Company, of Bronxville, N. Y., has issued Catalog E1, covering Ward Leonard circuit breakers, single pole types, in capacities up to and including 150 amp. While these single-pole overload circuit-breakers have but one handle, they consist of two switches in series so related that the circuit cannot be held closed when "overload" or "short circuit" exists. Underload and no-voltage release circuit-breakers are shown for battery and motor protection. The catalog states that Ward Leonard circuit-breakers are the only ones which received the gold medal at the Paris Exposition of 1900, and that they received the highest award at the St. Louis Exposition of 1904.

AIR PUMPS.—"The Wheeler-Edwards Air Pump" is the subject of an elaborate 32-page treatise published by the Wheeler Condenser & Engineering Company, Carteret, N. J. The peculiar action of the Wheeler-Edwards pump in handling both air and water is explained, and it is shown how the absence of foot and bucket valves, and an exceedingly small clearance, result in the attainment of a high vacuum, otherwise to be had only by means of separate dry vacuum pumps, hot well pumps and air coolers. Various types of these pumps are shown, also a number of large steam-turbine installations in which they are used. The latter half of the book is made up of the discussion of the principles of air pumps, tables or mixed vapors, and a complete and original table of saturated water vapor from 60 deg. to 180 deg. F., etc. The final section gives practical instructions for the handling of pumps of this character.

FEED WATER.—A treatise in pamphlet form has just been issued on this subject by the American Boiler Economy Company, North American Building, Philadelphia, Pa. This book describes the Copes boiler feed regulator and takes up in turn the several advantages to be gained by automatic regulation, such as protection to the boiler, protection to the engine or turbine, saving of cylinder oil, lessened friction and wear in the engine, higher efficiency of superheaters, higher efficiency of engines and turbines and greater economy from exhaust steam feed-water heaters and fuel economizers. The engineering considerations in regard to each of these points are brought out fully, bull's-eye charts from recording thermometers being shown, for instance, to demonstrate the fuel saving realized by holding the feed always equal to the evaporation.

DOMESTIC LIGHTING.—Under the title "'Tis of the Home We Speak," a very attractive and effective pamphlet has been issued by the Price-McKinlock Company, of Boston, Mass., a concern organized for manufacturing purposes, in which Mr. McKinlock, president of the Central Electric Company, and Mr. Price, treasurer of the Pettingell-Andrews Company, are representative of allied forces. The pamphlet deals broadly with questions of illumination in the home, for which work the Price-McKinlock Company has formed a department composed of experts in economical and artistic lighting. To this department the submission of a set of blue prints or drawings of a house is enough as a basis of work on the artificial lighting to be followed out in every respect, from the wiring to the completed and installed fixture. Several beautiful designs prepared by the company are shown from pencil drawings.

CROCKER-WHEELER COMPANY BULLETINS.—The Crocker-Wheeler Company, of Ampere, N. J., has recently issued four very interesting bulletins. No. 106 of its series treats of switchboard panels which can be assembled to form a switchboard of any size or capacity; No. 107 describes the company's well-known line of direct-current lighting and power generators of large sizes and contains a number of illustrations showing complete installations; No. 108 contains general information as to alternating currents, with formulas for calculating the ampere per phase, size of the generator and engine required, and explaining the importance of considering the power factor; No. 109 describes shall generating sets arranged from 2 to 19 kw, which are used to advantage for lighting plants for small hotels, apartment houses, etc. Altogether, this advertising literature is informing and very interesting.

Business Notes.

THE AMERICAN ELECTRICAL HEATER COMPANY, of Detroit, Mich., is constructing a new building at a cost of about $60,000. The company has not yet decided upon the equipment for the new building.

HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. J., have opened an office at 161 Sumner Street, Boston, Mass., in charge of Mr. H. F. Kellogg, to look after the growing demand in New England for the Hoyt instruments.

MR. H. G. FETHERLING, formerly with the Northern Electrical Manufacturing Company and later with the Pittsburg office of the Blaisdell Filtration Company, has reassociated himself with the Northern company as manager of the apparatus department. He will be located in the home office at Madison, Wis.

THE RUSSELL CAR & SNOW PLOW COMPANY, Ridgeway, Pa., has recently shipped a size 6 pedestal electric snow plow to the Bangor Railway & Electric Company, a similar car to the Lewiston, Augusta & Waterville Street Railway and a size 6 combination plow and car to the Ottawa (Can.) Electric Company.

ROBBINS & MYERS.—Owing to its increased business in the New England States, the Robbins & Myers Company has opened an office at 176 Federal Street, Boston, Mass. This office will be in charge of Mr. A. H. Coffin. The company will carry a large stock of fans and motors in Boston, in order to make immediate delivery and better attend to its New England trade.

PUMP CONSTRUCTION.—The American Well Works, Aurora, Ill., has issued a large and handsome catalogue with regard to its centrifugal pumps. There are 64 quarto pages of text and cuts and details are entered into very fully. Motors are used extensively in connection with these pumps, as shown. A great deal of useful data and information is contained in the pamphlet.

THE ERNER & HOPKINS COMPANY, of Columbus, Ohio, will move to a new six-story building on East Chestnut Street, soon after the first of the year, which is being fitted up especially for the electrical business. For several years the company has occupied a four-story building on North Fourth Street, but this space has been outgrown, and it became necessary to secure new quarters.

LAMP COLORING.—The Electric Motor & Equipment Company, 232 Market Street, Newark, N. J., has succeeded to the business of the American Chemical Company, conducted formerly by Mr. H. C. Swann at 79 Cortlandt Street, New York, and will continue to make and supply the "Faultless" weatherproof lamp coloring for incandescents, in 18 shades and colors, besides furnishing special tints to order.

DOSSERT & COMPANY, 242 West Forty-first Street, New York City, have received orders from the United Electric Light & Power Company, of New York City, for a large number of solderless connectors for use in the 146th Street substation, including elbows for connecting ingoing and outgoing solid buses through oil switches, lugs for connecting solid round to flat buses, special lugs on remote-control switches, and special two-way studs tapping from No. 0000 solid 10d direct to buses.

LINK-BELT COMPANY, Nicetown, Pa., reports orders recently booked and under way as follows: Connecticut, "Peck" overlapping bucket carrier; Cuba, cane-unloading machinery; Florida, belt conveyors for phosphate rock; Newfoundland, bucket elevator and special chain conveyor for chips; Pennsylvania, a number of elevators, flight conveyors, apron, belt and screw conveyors, hoppers, etc., for coal, and pan conveyors for clinkers; West Virginia, gravity discharge elevator, apron feeder and car haul for coal.

THE BELDEN MANUFACTURING COMPANY, Chicago, Ill., reports large sales of its emergency repair kit. Realizing the demand for quick shipments of repairs for motors and dynamos in emergency cases, it has provided an emergency kit, consisting of magnet wire, rubber and friction tapes and webbings, cotton sleeving, armature banding wires, solder, soldering sticks, pastes and salts. Because of the quick shipments the company can make of these complete repairing outfits, they are in great demand.

ADAMS-BAGNALL CO.—Mr. R. C. Campbell, district manager for the Philadelphia office of the Adams-Bagnall Electric Company, of Cleveland, Ohio, has recently returned from an inspection tour abroad and has found it necessary to open new offices in the Land Title Building, Philadelphia, where inquiries of any character concerning tungsten incandescent lamps, open or enclosed arcs, for operation under all conditions and on all circuits or any problem involving the field or science of illuminating engineering will receive his prompt attention.

THE CARBOLINEUM WOOD-PRESERVING COMPANY, New York, has made the following transfers and appointments on its staff: Mr. Fred. C. Bartels, Southern representative, transferred from St. Louis to the New York office; Mr. Robt. L. Felser, Pennsylvania State representative, present headquarters at New York office; Mr. Julius Perlowitz, Connecticut and Rhode Island representative, headquarters at New York office; Mr. Louis Edward Rusch, New York City representative; Mr. Edwin Scheftels, transferred from New York State to Milwaukee office.

HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, reports that Mr. Allen L. Haase, sales manager of the Company, has been traveling over the country recently in the interest of its steel brackets, conduit boxes, sectional switch boxes, fuse wire, electrical specialties, etc., and was in Cleveland during the past week, on his return from a Southern trip. Mr. Haase is enthusiastic about the prospects in all the cities he visited, including St. Louis, Louisville, Cincinnati, Indianapolis, Dayton, Columbus, Pittsburg. In his opinion, there will be great difficulty relative to deliveries during 1909, for the reason that the manufacturers will be unable to satisfy the demand. Since recovery from the August fire, which almost destroyed the Harvard plant, the factory has been working overtime. The total of the October orders taken was greater than any two months during the 1908 season.

W. B. McVICKER COMPANY.—Mr. W. B. McVicker has resigned as vice-president and Eastern manager of the Dearborn Drug & Chemical Works. He was connected with the Dearborn works for many years, having opened and developed all of the territory east of Chicago, including Cuba. His many friends and acquaintances will be interested to know that he has incorporated the W. B. McVicker Company, 115 Broadway, New York. A new and complete laboratory and factory are in course of construction and will be completed about Dec. 1. They will have exceptional facilities for general analytical work, and the manufacture of high-class products. A specialty will be made of scientific preparations for treating boiler feed-waters and hydraulic systems, also high-grade lubricants. The personnel of the company includes Charles M. Eddy, Albert E. Carpenter, Joseph F. Hammill, William J. Schatz, G. Frank Duemler and Frank J. Zink—men who have long been associated with Mr. McVicker.

THE WAGNER ELECTRIC MANUFACTURING COMPANY announces the appointment of Frank N. Jewett as general sales manager, with headquarters at the main office and factory in St. Louis. Mr. Jewett has been district manager of the Wagner company at Chicago for the past three years. He has a large acquaintance among the electrical fraternity, not only on account of his position with the Wagner company at Chicago, but also through having been for 10 years Western representative of Evans-Almirall & Company, of New York, in the sale and installation of central-station heating plants.

MR. J. R. GORDON has accepted the position of manager of power apparatus sales for the Western Electric Company for its Southern territory, making his home in Atlanta. Since he resigned from his position of manager in the Southern states for the Westinghouse Electric & Manufacturing Company he has received many flattering offers from Northern manufacturers, but decided that the large and growing business of the Western Electric Company presented opportunities quite to his liking, and also permitted him to remain in the South among his wide circle of social and business friends. Mr. Gordon is known as a pioneer in the electrical field, having been associated with those who organized and operated the first of the Edison plants. For many years he has been an active member of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

THE DOHERTY ELECTRICAL COMPANY, of Lockport, N. Y., has purchased the business of the Williamson Electrical Company and will carry on an electrical contracting supply business. Steven V. Doherty is president.

PIRELLI & COMPANY, the great manufacturers of insulated wires and cables at Milan, Italy, where they also make tires for automobiles, etc., were awarded grand prizes in each of the two sections in which they exhibited at the recent Marseilles Electrical Exposition.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 1, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

905,136. ALTERNATING-CURRENT MAGNET; T. E. Barnum, Milwaukee, Wis. App. filed April 16, 1905. Reduces the amount of current flowing through the coil when the armature has been attracted by providing an additional air gap to increase the self-induction of the magnetic circuit at the end of the stroke of the armature.

905,141. INSULATOR; Lawrence L. Bogue, East Orwell, Ohio. App. filed May 28, 1907. A solid oblong insulator with U-shaped grooves on its surface to receive the wires.

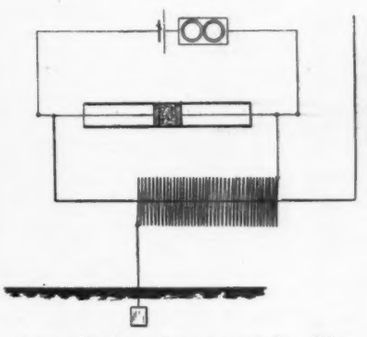
905,159. ELECTRIC HEATER; A. C. Dunham, Hartford, Conn. App. filed April 16, 1907. A water receptacle provided at the base of the heater, the water being heated electrically. Riser pipes carry the water upwardly and give circulation.

905,176. DEVICE FOR SUSPENDING BATTERY CRADLES; Emil Gruenfeldt, Cleveland, Ohio. App. filed Jan. 23, 1908. Particular construction for holding and locking in place the battery cradles used in electrical vehicles.

905,229. ELECTRIC CALL BELL; C. and W. Reinker, Lakewood, Ohio. App. filed April 27, 1908. Different tones are produced from the same gong, according to the station selected, by restricting the movement of the hammer so as to give a buzzing sound.

905,230. ELECTRICAL CONDUCTOR FOR DYNAMOS; W. J. Richards, Milwaukee, Wis. App. filed Aug. 15, 1904. Improves the electrical connection between wire and carbon in a pigtail brush by soldering a rivet to the pigtail, the rivet being mechanically connected to the brush.

905,554—Insulated Conductor.



905,537—Receiver Arrangement for Wireless Telegraphy.

905,266. SIGNAL APPARATUS; L. G. Woolley, Lima, Ohio. App. filed Aug. 31, 1906. Automatically tests signaling system at intervals. Special arrangement of magneto-electric generator and circuits.

905,308. AUTOMATIC RAILROAD SIGNAL; W. H. Harris, Stark, Mont. App. filed Dec. 16, 1907. An arm on the cab hits against pivoted arm-shaped rods arranged at intervals along the track. This closes an electric circuit, which is broken as the train leaves the block by the train hitting a second pivoted arm-shaped rod. These operations set the signals.

905,327. ELECTRIC SIGNALING SYSTEM; E. E. Kleinschmidt, New York, N. Y. App. filed Aug. 7, 1907. For direct-current trolley road. Alternaing current used for signals. A transformer in each track section receives alternating current and delivers induced current to a signal device in the car through connections between the other transformer member, the track and the section behind of a sectional conductor.

905,330. SHIELD FOR MOUTHPIECES OF TELEPHONES; Thurston M. La Jord, New York, N. Y. App. filed July 22, 1906. A reinforced blank, having members folded upon the body portion adapted to engage the mouthpiece.

905,347. CABLE TERMINAL; James E. McMeen, Galesburg, Ill. App. filed May 21, 1906. A sealed sleeve for a sectional cable, which contains insulated conductor terminals, flanges on the sleeve, weather shields extending from the flanges to the cable sheath and a cover clamped upon the flanges to house the terminals.

905,349. SEAL FOR ELECTRIC WIRES; O. W. Neal, B. W. Shaw and H. J. Howarth, Portland, Maine. App. filed Aug. 15, 1908. To cover dead ends when meter is taken out. An insulating casing in two parts enclosing the dead ends and a seal for securing them together.

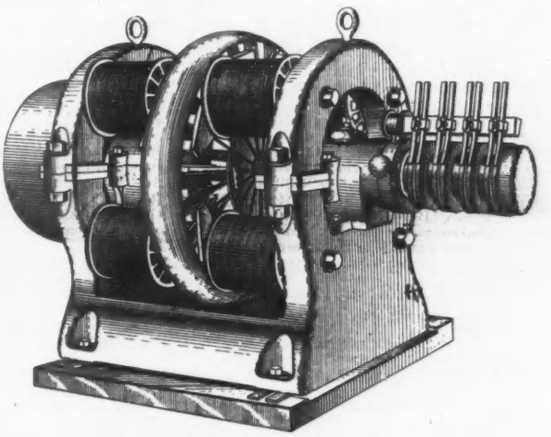
905,351. TROLLEY RETRIEVER; C. Norland, Los Angeles, Cal. App. filed March 7, 1907. A spring drum with a connection to the trolley rope; automatically draws the trolley down when it is disengaged from the wire and also keeps proper tension on the trolley rope.

905,364. FLOOR BOX AND RECEPTACLE; N. H. Raymond, Trumansburg, N. Y. App. filed July 7, 1908. Particular construction of floor sockets, with hollowed out body into which the socket is fitted.

905,378. FIRE AND TEMPERATURE ALARM OR INDICATOR; G. L. Smith, Aberdeen, Scotland. App. filed May 22, 1908. Improvement on patentee's prior patents, in which a reservoir of compressed air gives a signal upon a stoppage of the flow of pressure or upon a break occurring in the metal tube which extends through the place where the rise of temperature is to be indicated.

905,402. METHOD OF REMOVING CARBON FROM METALLIC FILAMENTS; Werner Von Bolton, Charlottenburg, Germany. App. filed June 2, 1908. Highly heats the filament in an atmosphere of acetic acid vapors.

905,414. METALLIC INSULATOR PIN; C. G. Ette, St. Louis, Mo. App. filed Dec. 24, 1907. For telegraph wires and the like, so constructed that the expansion of the metal of the pin will not break the insulator. A longitudinally extending slot in the pin and screw threads of oval shape to co-operate with screw threads of circular shape on the insulator provide for the necessary expansion.



905,512—Dynamo Electric Machine.

905,458. GLOBE CLEANER FOR ARC LAMPS; R. H. Read, Schenectady, N. Y. App. filed Oct. 25, 1906. For cleaning globe of flaming arc-lamp with carbid electrodes. One or more wipers extend lengthwise of the glove, and means are provided for rotating the globe to clean it.

905,459. FLATIRON STOVE; E. W. Rice, Jr., Schenectady, N. Y. App. filed May 11, 1908. When the iron is placed on the stand the circuit is closed and the iron heated, and when the iron is removed the circuit is broken. The stand gives the iron a bias toward the circuit closer.

905,478. INCANDESCENT LAMP; A. Swan, New York, N. Y. App. filed June 7, 1905. The base of the lamp is provided with an insulating web with an opening, leading-in wire extending through and movable in the opening, long enough to extend beyond the web, and a center contact is soldering to the end of the leading-in wire.

905,495. ELECTRORESPONSIVE DEVICE; E. A. Buckman, Chicago, Ill. App filed July 1, 1907. Call bell, in which the core of the magnet consists of a spirally wound strip of sheet metal.

905,497. TELEGRAPH TYPEWRITER; G. A. Cardwell, New York, N. Y. App. filed March 18, 1907. Three impulses from the main line circuit position the printing wheel. A plurality of main circuits, a plurality of secondary circuits branching therefrom, a tertiary circuit branches from each secondary circuit, all the circuits being normally open. Means are provided for closing the respective circuits to position the wheel.

905,503. NON-EXPLOSIVE FUSE; F. B. Cook, Chicago, Ill. App. filed May 3, 1906. Polygonal end caps with radial channels provide vents for the gas generated when the fuse is blown.

905,508. CONTROL OF SEPARATELY EXCITED GENERATORS PROVIDED WITH AUXILIARY POLES; L. Fleischmann and G. Stern, Berlin, Germany. App. filed March 11, 1908. Particularly designed for hoisting motors. A separately exicted generator with an auxiliary field drives a motor. Means are provided for controlling the main field of the generator to vary the voltage supplied to the motor and also means for "killing" the auxiliary field when the main field is broken.

905,509. SYSTEM OF DISTRIBUTION; Lionel Fleischmann, Berlin, Germany. App. filed April 10, 1908. A plurality of single-phase transformers are so connected across the polyphase system as to have an unstable neutral, and a star-connected polyphase reactance is connected across the system, with its neutral point connected to the neutral point of the single-phase transformers.

905,512. DYNAMO ELECTRIC MACHINE; Charles M. Green, Lynn, Mass. App. filed Aug. 12, 1903. Relates particularly to Brush arc light machines; reduces the air resistance to the rotation of the armature by providing a shield therefor made of a strip of fabric which closely embraces the armature.

905,513. SIGNAL SYSTEM; J. L. Hall, Schenectady, N. Y. App. filed Jan. 30, 1908. A plurality of receiving magnets, each with a plurality of magnet windings, are supplied from a plurality of current sources. An independent lead connects each source and one of said receiving devices. A group of leads are common to the receiving devices, the several magnet windings being connected to different leads of the group, and a switch for each source is arranged to connect the source to any lead of the group.

905,514. ARC LAMP; C. A. B. Halvorson, Jr., Lynn, Mass. App. filed Oct. 31, 1906. Periodically removes the coating to deposit it on the electrode of an arc lamp having a pendulum electrode by a suitably actuated scraper.

905,515. ARC LAMP; C. A. B. Halvorson, Jr., Lynn, Mass. App. filed April 6, 1907. Controls the holding clutch of an arc lamp by means of an auxiliary armature.

905,537. RECEIVER ARRANGEMENT FOR WIRELESS TELEGRAPHY; Gerhard Jahy, Berlin, Germany. App. filed June 12, 1907. The antenna is not grounded, but is led through a coil of wire and connected with one pole of the coherer. The end of the coil at which the antenna enters into the interior of the coil is connected with the other pole of the coherer. The other end of the coil is grounded. Responds to very feeble waves.

905,554. INSULATED CONDUCTOR; Joseph I. Mitchell, Schenectady, N. Y. App. filed Sept. 14, 1903. An insulated strip conductor, consisting of a flat srip of metal, a flat ribbon of insulating material lying against one side of the strip of metal and a textile jacket covering the strips.

905,557. ARC-LIGHT ELECTRODE; Berthold Monasch, Berlin, Germany. App. filed May 16, 1906. One or more metallic compounds, with 5 to 90 per cent of silicon carbid.

905,588. ELECTRIC CONTROLLER; R. R. Root, Cleveland, Ohio. App. filed Feb. 8, 1906. Uses an arc-lamp as one element of the resistance. Electrical means for separating the carbons of the arc light and mechanical means, including a pivoted hand-operated lever for closing the gap between the carbons.

905,594. DEVICE FOR LOCATING A MOLTEN DISTRIBUTING FUSE; F. Schultz, Münster, Germany. App. filed Feb. 15, 1907. A voltmeter at the central station locates the blow-out. A feeder and pilot wire with a fuse in the circuit of feeder and pilot wire are provided so that when the fuse blows the electrical connection between the feeder and pilot wire is disconnected.

905,597. ELECTRIC FLUID HEATER; J. S. Smyser, Harwich, Mass. App. filed April 4, 1908. Electrolytic heater, in which the water is heated by the current passing through it, comprising a plurality of spaced parallel plates, the alternate ones being connected in multiple to form opposite electrodes, with means for maintaining a fluid between the electrodes to complete the circuit.

905,599. NEGATIVE POLE ACCUMULATOR ELECTRODE; E. Sokal, Chicago, Ill. App. filed Aug. 22, 1907. Prevents shrinkage of the negative active material of the storage battery by mixing with the material a small percentage of lead dust.

905,619. TELEPHONE-EXCHANGE APPARATUS; Ernest E. Yaxley, Chicago, Ill. App. filed Sept. 26, 1905. An enunciator having an electro-magnet in the shell, the spool being within the shell, a locking device adapted for locking connection by rotation of the spool with respect to the shell and a fastening device for preventing the rotation of the spool with respect to the shell when the members of the locking device are engaged.

905,621. ALTERNATING-CURRENT HIGH-FREQUENCY GENERATOR; F. F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 6, 1905. For frequencies of 100,000 per second. The armature is fixed and the poles consist of two rotary disks of magnetic material, which taper and have polar projections on the peripheries of the disks. A stationary coil magnetizes the disks.

905,628. TELEGRAPHIC REPEATING APPARATUS; W. E. Athearn, New York, N. Y. App. filed April 29, 1908. A circuit having at each of two stations a current reversing transmitter and a polarized relay, a single transmission circuit which controls the transmitter at one station and is itself controlled by the relay at the same station.

905,632. DEVICE FOR ADMITTING GAS INTO VACUUM TUBES; H. Bauer, Berlin, Germany. App. filed June 2, 1908. A faucet provided with a hollow chamber. In one position the passages of the faucet are connected with the atmosphere, and on the other hand with the hollow chamber, so that the latter is filled with a definite quantity of gas. On turning the faucet this quantity of gas passes into the vacuum tube.

905,675. BRUSH HOLDER; H. F. T. Erben, Schenectady, N. Y. App. filed Oct. 17, 1903. For high-speed machinery. Particular construction of brush holder.

905,697. MOTOR CONTROL SYSTEM FOR ELECTRIC VEHICLES; M. R. Hanna, Schenectady, N. Y. App. filed March 16, 1908. Avoids the "flash over" or arcing from brush to brush on street railway motors when the wheels slip by interrupting all the controlled circuits, except those which lead to the switches, which connect the motor circuits to the source of current supply, and those which arrange the motors in the series or starting position.

905,703. INCANDESCENT ELECTRIC LAMP; H. J. Jaeger, New York, N. Y. App. filed Nov. 4, 1907. Relates to lamps with long filaments having a number of loops in series with each other. Provides insulating disks to receive and support the filaments, so as to permit hanging the lamp in any position.

905,713. SELF-REGULATING ELECTRICALLY PROPELLED VEHICLE WITH LIMITED VARIATIONS IN INTENSITY; L. Kriefer, Paris, France. App. filed Jan. 10, 1906. Improvement on prior patents of the inventor. A generator arranged to deliver constant watts is provided with a variable voltage exciter, a motor having armature and field windings, one of which is energized from the generator and the other from the exciter.

905,734. AUTOMATIC SELF-STARTER; C. H. Miller, Milwaukee, Wis. App. filed April 10, 1905. Particular construction of self-starters for motors. The starting solenoid is smaller than the usual starting magnet, since it is in action for only a short time. An auxiliary solenoid is provided, which controls the motor circuit.

905,746. OPERATING DIRECT-CURRENT GENERATORS IN MULTIPLE; F. W. Peek, Jr., Schenectady, N. Y. App. filed April 8, 1908. Voltage regulator of the Tirrill type. A voltage regulator for each generator, containing a main control magnet having a differential winding, one portion of which is responsible to changes in the current of its individual generator, and the other portion to changes in the line current.

905,761. SEALING CAP FOR ELECTRICAL APPARATUS; J. G. Swallow, Brooklyn, N. Y. App. filed March 6, 1908. Improvement on prior patent to inventor. Special construction of cut-out with fuse plugs, cover and supplemental cap secured by seals.

905,773. GROUNDING CLAMP FOR ELECTRIC WIRES. Wheeler H. Vibber, New London, Conn. App. filed April 11, 1908. Particular form of clamp, consisting of a strap embracing the wire with two ends to receive a clamping screw.

905,781. TELEPHONE RECEIVER; Nathaniel Baldwin, Heber, Utah. App. filed Jan. 29, 1908. A magneto telephone, with a permanent magnet, an armature, means for causing both poles of the magnet to act on each side of the armature.

905,782. ELECTROMAGNETIC SWITCH; T. E. Barnum, Milwaukee, Wis. App. filed July 5, 1906. Particular form of magnet for alternating currents, which reduces the amount of current when the armature has been attracted and for giving a hammer blow to the switch operated by the magnet.

905,784. MOUNTING FOR TROLLEY HEADS; J. J. Bennett, Pittsfield, Mass. App. filed Aug. 6, 1906. Particular construction of mounting to permit the trolley wheel to follow the wire at all times.

905,790. MOTOR CONTROLLER; A. H. Buckelew, Newark, N. J. App. filed Feb. 21, 1905. For dental motors, in which the controller, instead of being moved by the foot of the operator, is operated by a pilot motor controlled by push buttons.

905,792. SNAP SWITCH; E. S. Capello, Schenectady, N. Y. App. filed Oct. 8, 1907. Avoids jamming of the switch by combining with the spindle a catch plate having a slot and an actuator engaging the slot and sliding transversely of the spindle.

905,797. ALTERNATING-CURRENT CLUTCH; A. G. Davis, Schenectady, N. Y. App. filed March 27, 1908. Magnetic clutch which is operated by the repulsion between two windings in inductive relation to each other, carrying alternating currents flowing in opposite directions in the windings. One of the windings may be short circuited and the current induced in it by the other winding.

905,800. ARC LAMP; John T. H. Dempster, Schenectady, N. Y. App. filed Feb. 29, 1904. For starting the arc by heating the tip, so as to make it a good conductor. Provides a second electrode in proximity to the tip, with means for heating it so as to raise the temperature of the tip.

905,805. DYNAMO ELECTRIC MACHINE; S. S. Forster, Schenectady, N. Y. App. filed July 20, 1905. Particular construction of means for supporting the laminas of the core of a dynamo by U-shaped members engaging the laminas.

905,810. RAILWAY RAIL BOND; A. Gething, Enterprise, W. Va. App. filed Jan. 9, 1907. For bonding rails to be used as signal circuits. Comprises a flat metallic bar of special construction secured between the fish plate and the rails.

905,812. ELECTRICAL CONNECTION; P. E. Gilling, Camden, N. J. App. filed March 20, 1906. For grounding the outside of cables. Formed of a piece of tubing with the sides pressed together, the end bent to form a loop embracing the cable and clamped thereto by a screw.

905,814. DYNAMO ELECTRIC MACHINE; C. M. Green, Lynn, Mass. App. filed Nov. 8, 1904. Relates particularly to Brush arc-light machines, with a pole shoe at one side of the armature laminated perpendicularly to the plane of the revolution of the armature, the permeability of the laminas reduced at the pole tips.

905,815. APPARATUS FOR THE MAGNETIC SEPARATION OF ORE; Gustaf Grondal, Djursholm, Sweden. App. filed June 25, 1907. Improvement on prior patent to same inventor. Makes use of an endless conveyor band, which passes between the magnets and the sluice containing water and ore.

905,816. CLOCK; A. L. Hahl, Chicago, Ill. App. filed Sept. 26, 1903. For automatically winding the motor spring at intervals, and in which the work of closing the contacts is mainly done by the armature of the winding magnets.

905,817. DYNAMO ELECTRIC MACHINE; F. B. Howell, Schenectady, N. Y. App. filed April 17, 1908. Commutating pole pieces which are laminated and are provided with fastening poles of the same cross-section as the laminations.

905,819. AUTOMATIC CARRIER SYSTEM; C. W. Larson, Schenectady, N. Y. App. filed Jan. 2, 1906. Improvement in ash carrying systems. The carrier is driven from a motor and connected thereto by a cable. Reversing control apparatus for the motor is controlled by a device on the motor.

905,361. METHOD OF PRODUCING AND UTILIZING OZONE; H. N. Potter, New Rochelle, N. Y. App. filed Jan. 6, 1904. Passes an electric current between electrodes inside a container made of silica. This container is surrounded with an envelope which is opaque to ultra-violet rays. The envelope is provided with an air inlet and outlet passage for generating and transferring the ozone.

905,572. METHOD OF STRIKING VOLTAIC ARCS; A. J. Petersson, Alby, Sweden. App. filed Nov. 3, 1905. Strikes arcs in a gas mixture, by leading gases through a furnace chamber, striking electric arcs of low intensity between electrodes in the furnace and moving the arcs by magnetic action to electrodes of other circuits, for striking arcs of higher intensity between the last-mentioned electrodes.

905,666. ELECTRODE; A. G. Davis, Schenectady, N. Y. App. filed July 29, 1904. An apparatus for electric treatment of gases containing an electrode consisting of iron chemically combined with another element, a co-operating electrode and means for delivering to said electrodes a gas to be treated.

905,785. ELECTROLYTIC SOLUTION FOR ZINC PLATING; Celestino Bianco, New York, N. Y. App. filed July 16, 1907. The electrolyte contains compounds of zinc and iron and an acetate of an alkali metal.